PREVENTING PIT AND FISSURE CARIES: A GUIDE TO SEALANT USE

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A National Institutes of Health Consensus Development Conference on Dental Sealants (December 1983) unanimously endorsed the placement of dental sealants as a highly effective and safe means of preventing dental caries (tooth decay) on the surfaces of noncarious teeth that contain pits and grooves. These surfaces are most susceptible to decay. Sealants are thin coatings of plastic film that are placed without removal of sound tooth structure and create a barrier to the accumulation of food debris and bacteria. The combined use of dental sealants and fluorides provides optimum caries protection and has the potential to achieve total prevention of tooth decay.

Dental sealants are currently underused in both public and private health care delivery systems. Intensive efforts should be undertaken to increase their use. Widespread use would substantially reduce dental decay below the levels that already have been achieved by the use of fluorides and other preventive measures. The greater use of sealants would lead to an improvement in the public's health, as well as reduce the future need for dental repair.

Health agency directors and practitioners are urged to incorporate the appropriate use of dental sealants into their programs and practices and to increase the public's awareness of this excellent preventive measure. Dental educators should place greater emphasis on teaching students the rationale for the use of sealants and proper techniques of application.

—C. Everett Koop, M.D.
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FOREWORD

This guide is for those who use or intend to use sealants in caries preventive programs. It explains what sealants are, their effectiveness, and when and how they should be used. *Preventing Pit and Fissure Caries: A Guide to Sealant Use* is a resource for dentists and dental auxiliaries offering sealants as part of their individual care preventive programs and for public health professionals who are responsible for the planning and implementation of community preventive dentistry programs.

The first section presents an overview of sealants, including the rationale for sealant therapy, the different types of marketed sealants, and the histological and microbiological considerations associated with their use. This section should be read by all users of this guide because of the basic information contained. The second section, describing the technic of sealant application, is also intended for all readers. Sections III and IV describe the use of sealants in office programs and in public programs respectively. Thus, Section III is meant for private practitioners and others who provide individual patient care, while Section IV is intended for public health personnel. The appendix contains information of use to either provider of care.

This guide was prepared by a committee of individuals knowledgeable about sealant therapy. The recommendations presented are based on an evaluation of the current dental literature or, where a dearth of scientific information exists, a consensus opinion developed by the committee. While it is intended that the guide both foster and facilitate the use of sealants, the committee emphasizes that a complete preventive dentistry program also includes the appropriate use of systemic and topical fluorides, proper diet, good oral hygiene practices, and regular professional care.

— Louis W. Ripa

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— Virginia Callanen
— Gregory Connolly

ABBREVIATED CONTENTS

A comprehensive table of contents precedes each section.

SECTION I
THE USE OF SEALANTS

CONTENTS

INTRODUCTION

Sealants are dental resins that are applied to the pits and fissures of teeth to inhibit dental caries. Because they contain no therapeutic ingredient, their success lies in their ability to adhere firmly to the enamel surface and to isolate the pits and fissures from the rest of the oral environment. The sealant acts as a physical barrier, preventing oral bacteria and dietary carbohydrates from creating the acid conditions that result in caries (Fig. I—1).

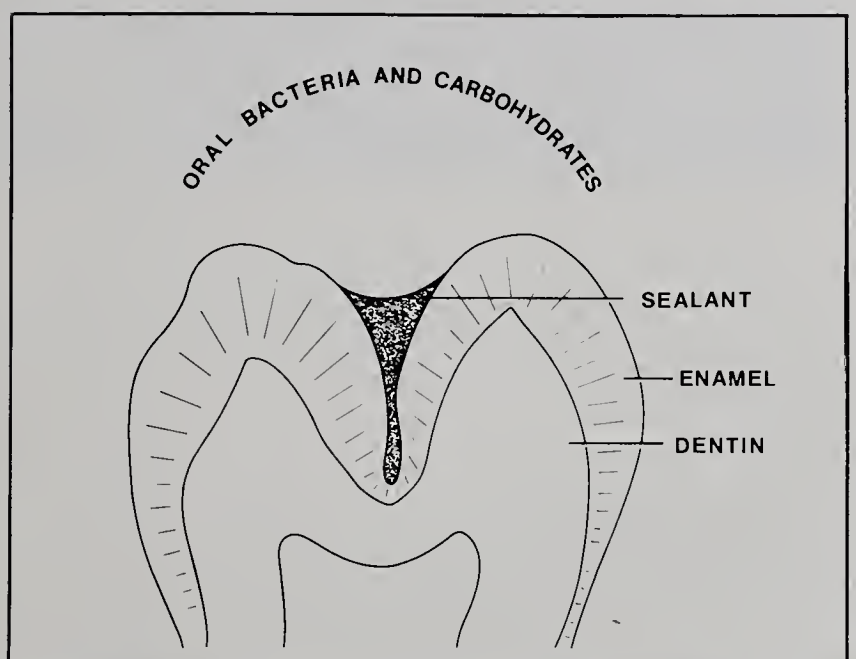


FIG I—1 The sealant prevents caries by physically occluding the pits and fissures

The first clinical sealant trial was reported in 1965.[1] Since then, there have been many clinical and laboratory reports documenting their safety and effectiveness. The first provisional acceptance of a marketed sealant by the American Dental Association was granted in 1972,[2] with full acceptance in 1976.[3] In 1983, a Consensus Development Conference, sponsored by the National Institutes of Health, declared sealants to be a safe and "highly effective means of preventing pit and fissure caries."[4]

NEED FOR SEALANTS

Caries prevalence among American children is declining. The National Caries Prevalence Survey, conducted in 1979-80 by the National Institute of Dental Research, found that 37 percent of school children (ages 5-17 years) were caries free, and that the average school child has 4.8 tooth surfaces decayed, extracted or filled.[5]

The decline in tooth decay, however, is dissimilar for the different tooth surface types. Comparison of the results of the 1979-80 survey to those of a similar survey, conducted in 1971-74 by the National Center for Health Statistics, shows that the greatest percentage decline, 52.9 percent, has occurred on the smooth proximal surfaces. The percentage decline for occlusal and buccolingual surfaces is each only one-half that amount (Table I—1).[6]

TABLE I—1

Mean Caries Prevalence (DMFS) of Specific Tooth Surfaces in United States School Children

Surface	NCHS Survey 1971-74	NIDR Survey 1979-80	Difference No.	Difference %
Proximal	1.7	0.8	- 0.9	52.9
Buccolingual	1.9	1.4	- 0.5	26.3
Occlusal	3.5	2.6	- 0.9	25.7

Source: Brunelle, J.A. and Carlos, J.P., J Dent Res, 1982

The disproportionate percentage reduction in caries of the different tooth surfaces alters the relative distribution of decay (Table I—2).[6] In 1971-74, the proximal surfaces accounted for 24 percent of the caries found in United States school children: In 1979-80, proximal caries comprised only 17 percent. Conversely, the *percentage* of both occlusal and buccolingual caries increased. Caries of the buccal and lingual surfaces in children most frequently involves the pits and fissures. Because of the proportional decline in smooth surface decay, 83 percent of all caries or fillings in school children now occurs on the buccal, lingual, and occlusal surfaces (Table I—2). Thus, caries in United States children has become predominantly a disease of the pits and fissures. Furthermore, while caries of all tooth surface types is lower in optimally fluoridated communities compared to those that are fluoride deficient, the same high proportion of pit and fissure caries prevails in both communities (Table I—3).[7] Hence, the need for sealants is unaffected by the fluoridation status of the community.

TABLE I—2
Relative (Percentage) Distribution of Caries in Specific Tooth Surfaces of United States School Children

Surface	NCHS Survey 1971-74	NIDR Survey 1979-80
Proximal	24	17
Buccolingual	27	29
Occlusal	49	54
Total	100%	100%

Source: Bruncllc, J.A. and Carlos, J.P., J Dent Res, 1982

TABLE I—3
Relative (Percentage) Distribution of Caries in Specific Tooth Surfaces of United States School Children from Optimally Fluoridated and Fluoride-Deficient Communities

Surface	Fluoridated Communities	Fluoride-Deficient Communities
Proximal	6	11
Buccolingual	40	35
Occlusal	54	54

Source: Bohannan, H.M. J. Public Health Dent, 1983

Teeth are not equally susceptible to decay. As seen in Table I—4, newly erupted permanent molars develop caries faster than newly erupted incisors, cuspids or premolars, and a considerably higher percentage of molars decay than do other teeth.[8] The high caries attack rate in molars undoubtedly accounts for the decline in caries free children, from 57 percent in six to eleven year olds to 17 percent in twelve to seventeen year olds.[6] Sealing newly erupted molars not only would reduce the incidence of decay in the most caries susceptible teeth in the mouth but also would increase the number of teenagers graduating from high school with an intact dentition.

TABLE I—4

Percentage of Each Tooth Type Decayed By Age

Fluoridated Sites					**Age**			
Tooth	6	7	8	9	10	11	12	13
U Central				0.5	0.9	2.0	2.2	4.1
L Central						0.8	1.1	1.1
U Lateral			0.5	1.1	1.5	4.1	5.2	6.1
L Lateral								0.5
U Cuspid								
L Cuspid								
U 1st Premolar					0.8	2.2	3.1	5.2
L 1st Premolar						1.3	1.6	2.6
U 2nd Premolar					0.6	1.6	3.5	5.6
L 2nd Premolar					0.6	2.4	3.7	6.2
U 1st Molar	6.7	18.9	30.5	38.8	47.8	53.6	54.8	58.2
L 1st Molar	10.9	24.8	38.2	43.7	52.5	59.6	62.6	65.5
U 2nd Molar						4.4	10.7	17.5
L 2nd Molar					1.7	8.7	17.6	29.9

Fluoride-Deficient Sites					**Age**			
Tooth	6	7	8	9	10	11	12	13
U Central				0.8	2.3	4.9	7.0	9.7
L Central					0.6	1.3	1.7	1.9
U Lateral			0.5	1.3	3.0	6.5	9.3	13.4
L Lateral						0.9	1.3	1.4
U Cuspid						0.5	0.9	1.7
L Cuspid								
U 1st Premolar					1.9	3.6	5.8	10.6
L 1st Premolar					0.8	2.8	4.3	6.6
U 2nd Premolar				0.6	1.2	3.3	5.8	10.4
L 2nd Premolar					1.3	4.5	7.5	12.4
U 1st Molar	8.3	22.1	40.1	46.9	56.7	65.0	69.3	71.1
L 1st Molar	12.2	27.6	44.6	49.5	58.7	65.3	72.3	76.4
U 2nd Molar					1.2	6.6	17.8	32.0
L 2nd Molar					2.5	12.0	27.3	44.2

Source: Bohannan, H.M. et al, J Dent Ed, 1984

TYPES OF SEALANTS

Most commercially available sealants utilize a liquid resin monomer whose base is the reaction product of bis-phenol A and glycidyl methacrylate (Bis-GMA).[9] The same material also forms the base of many of the modern composite restorative systems. In order to be used as a dental restorative, the Bis-GMA resin is strengthened by the addition of filler particles such as glass, porcelain, or quartz. A few of the marketed sealants also contain fillers (see Appendix). Because the amount of filler particles that they contain is at least one-half of the amount found in restorative materials, these sealants are called "partially filled." Most of the available sealants, however, contain no filler particles and are "unfilled."

Even though the base is the same, there are compositional differences between the commercial sealants that can alter their physical properties. Different sealants vary in their coefficient of thermal expansion, water absorption, compressive and tensile strength, elasticity and dimensional stability. While these differences can be measured in a laboratory, their effect on the relative clinical success of different sealant brands is not known. Consequently, these property differences need not be a consideration when choosing which sealant to use. On the other hand, there are differences between marketed sealants that have practical clinical implications concerning their selection and use. These differences include the method of polymerization, the presence of fillers, and the presence of coloring agents.

Method of Polymerization

There are two methods of polymerization: (1) chemical or autopolymerization and (2) photopolymerization. The manufacturers of chemically polymerized systems supply a liquid catalyst, such as benzoyl peroxide, that is mixed with the liquid resin monomer in order to harden the material. Photocured systems contain an initiator that is activated by an intense light of specific wave length. The light is emitted by hand-held curing units. The first marketed Bis-GMA sealant was initiated by ultraviolet light. More recently marketed sealants use relatively intense visible light to affect polymerization, and the curing units emit light in a spectral range approximately of 380 to 600 nanometers (nm).

The advantage of autopolymerized products is the lower capital cost since a light curing unit and protective glasses for the eyes are not required. The disadvantage of this system is that the operator cannot control the setting time once the catalyst has been added.

The advantage of a photoactivation system is that the operator has control over the initiation of the setting process. Also, this type of system can be used easily with other bonding technics such as the repair of fractured anterior teeth and the esthetic restoration of developmental defects. The disadvantages are the capital cost for the curing unit and the need to protect the operator's eyes when the unit is being used.

Although an ultraviolet light initiated product was one of the first marketed sealants, the use of ultraviolet light initiated sealants has declined. Technical problems with the early ultraviolet light curing units may have contributed to this trend. Autopolymerized sealants were the second type of sealant to be marketed, and clinical studies have shown that they are retained longer than the ultraviolet light initiated sealants. Improved retention is an important consideration when selecting a sealant.

The newest marketed sealants are those initiated by visible light. While insufficient clinical data have been published to compare their retention to that of the autopolymerized sealants, the American Dental Association has granted full or provisional acceptance to some brands of visible light sealants indicating that they are safe and effective. Visible light cured sealants are gaining in popularity with the profession, partially because of their ease of utilization and versatility in both preventive and restorative dentistry.

Presence of Fillers

Manufacturers of sealants that contain inert fillers claim that a partially filled sealant is more resistant to the abrasive action of the opposing teeth. However, there is no evidence that sealants fail because of wear or that sealants with filler particles clinically outperform those without fillers.[10] When an unfilled sealant is used, high spots, which are inevitable, are worn away by the patient's own occlusion in a few days. Partially filled sealants will need equilibration when they are high. The use

of partially filled sealants, therefore, has no known advantage, but may have the disadvantage of increasing treatment time.

Colored Sealants

The hardened sealant may be clear, white or tinted. White sealants contain a small amount of opaquing agent, such as titanium dioxide. Sealants that are white or tinted can be seen easily, in contrast to clear sealants. The visibility factor may allow for more accurate placement at the application visit and better visualization of the sealant upon recall. While better visibility is an advantage of tinted or opaque sealants, some patients have complained that they are not esthetic. Dentists can overcome this objection by using a white or tinted sealant on the molars and a clear sealant on the premolars.

SEALANT EFFECTIVENESS

Success of a caries preventive agent is judged by the degree of caries inhibition achieved by its use. This is true for sealants. Because sealants prevent caries by their physical presence rather than by a chemical reaction with the teeth, the caries protection may also be determined by the sealant's ability to remain adhered to the tooth. As long as the sealant remains intact, caries will not develop beneath it. In this context, the longevity of a sealant on a tooth, its retention, is a prime determinant of success.

Retention

Sealant retention has been documented in a large number of clinical trials.[11] Table I—5 lists the results of more than 60 reports that give the percentage of permanent teeth having their occlusal pits and fissures completely covered with sealant, one to seven years after treatment.

The highest rate of sealant loss occurs during the first year, when improperly applied sealants fail. Thereafter, the rate of loss is less as firmly bound sealants continue to protect the occlusal surface from decay. Seven years after application, one study reported an impressive 49 percent of treated teeth were still completely covered.[12] Thus, years of protection were provided to the most caries-susceptible tooth surfaces with only a single treatment.

As seen in Table I—5, the first generation ultraviolet light sealants gave good results and helped to establish scientifically the success of the sealant procedure in preventive dentistry. The advent of the autopolymerized sealants further secured the importance of this caries preventive procedure by both confirming and surpassing the results that were obtained with the ultraviolet light initiated sealants.

Visible light initiated systems are the newest type of marketed sealant. Unfortunately, there are too few published studies of this type of sealant to allow a comparative evaluation of their clinical

TABLE I—5

Retention of Occlusal Sealants on Permanent Teeth

Years after Sealant Placement	Number of Reports	Percent Retention on Completely Covered Teeth			
		Average of All Reports	Range	Autopolymerized Sealants	Ultraviolet Light Initiated Sealants
One	29	80	18-100	83	76
Two	24	71	3-96	83	62
Three	15	58	11-94	72	44
Four	8	51	22-88	70	38
Five	3	43	19-67	67	31
Six	2	54	37-68	63	37
Seven	1	49	31-66	66	31

Source Ripa, L.W., J Canad Dent Assn, 1985

performance relative to the other sealant types, and they are not included in the table. Since some brands of visible light sealant have been granted acceptance or provisional acceptance by the American Dental Association, comparison between the longevity of these newer sealants and the other sealants should be possible in a few years. The results of such comparisons are important because practitioners and public health personnel should use sealants that have proven superior in controlled clinical trials.

The range of sealant results listed in Table I—5 is wide. This disparity is sometimes confusing to individuals who are unfamiliar with the sealant technic. Because successful sealant therapy requires that sealant be retained on the tooth surface, the life of the sealant is determined by the operator's skill and by the clinical conditions at the time of placement. Several studies have shown that retention rates can vary significantly between similarly trained operators.[13,14] These findings indicate that the clinical skill and ability of the operator is very important in determining success. In some studies where retention was poor, it was difficult to achieve adequate moisture control.[15,16] In the earlier studies, the need for complete dryness and a meticulous technic may not have been fully appreciated. The principal intraoral factors affecting the operator's ability to maintain a dry field are the position of a tooth in the mouth and its degree of eruption. That is why sealant retention is reportedly better on premolars than on the more difficult to isolate molars, and better for older than younger patients.

Caries Reduction

Table I-6 presents the occlusal caries reductions for permanent teeth obtained from 41 reports of approximately two dozen sealant studies.[11] By averaging the results on an annual basis there are very respectable occlusal caries reductions of 82, 68, 65, 43, 36, 40 and 34 percent from one through seven years after sealant application, respectively. Since, in most of these studies sealants were applied only at the initial treatment visit, the results represent a dramatic reduction in caries on the most susceptible tooth surfaces, achieved with a minimum amount of professional time.

Primary Teeth

The first clinical reports of occlusal sealant treatment on primary teeth found lower retention rates than on permanent teeth. Because of these studies, some clinicians recommend that a surface layer of occlusal enamel be ground off primary teeth or that primary teeth be acid conditioned longer than permanent teeth. Since the initial publications, there have been more than one dozen reports in which sealants were placed on both primary and permanent teeth in the same clinical program. The results of these studies, summarized in Table I—7, do not substantiate the earlier findings. While more studies of longer duration would be useful, the present findings indicate that comparable rates of retention can be achieved for primary and permanent teeth. No special treatment is required when applying sealants to primary teeth.

TABLE I—6

Occlusal Caries Reductions from the Use of Sealants on Permanent Teeth

Years after Sealant Placement	Number of Reports	Percent Occlusal Caries Reduction			
		Average of All Reports	Range	Autopolymerized Sealants	Ultraviolet Light Initiated Sealants
One	13	82	65-100	81	83
Two	13	68	14-99	82	68
Three	8	65	36-85	66	63
Four	6	43	22-62	59	31
Five	4	36	17-58	51	34
Six	2	40	8-56	56	8
Seven	1	34	12-55	55	12

Source Ripa, L.W., J Canad Dent Assn, 1985

TABLE I—7

Comparison of Retention of Occlusal Sealants on Permanent and Primary Teeth

Years after Sealant Placement	Number of Reports	Percent Retention on Completely Covered Teeth	
		Permanent Teeth	Primary Teeth
One	9	73	79
Two	7	63	64
Three	3	37	55
Four	1	25	14
Five	1	19	13

BONDING

For sealants to be successful, they must form a strong bond with the enamel surface. In its natural state, however, enamel is a poor substrate for bonding. It is covered by a thin, microscopic film, called a pellicle, composed of salivary proteins. On top of the pellicle a layer of bacterial plaque forms. The complex morphology of the occlusal surface, with its pits and fissures, makes it a convenient site for the collection of these organic deposits (Fig. I—2). The presence of these deposits prevents a sealant from adhering directly to the tooth surface and from forming a strong bond with the enamel. Miura and co-workers have shown that for maximum bond strength when applying sealants, a prophylaxis must be performed.[17] This is done with an aqueous slurry of flour of pumice. There is no scientific evidence that hydrogen peroxide, advocated by some to clean the teeth, is a suitable substitute for pumice prophylaxis.

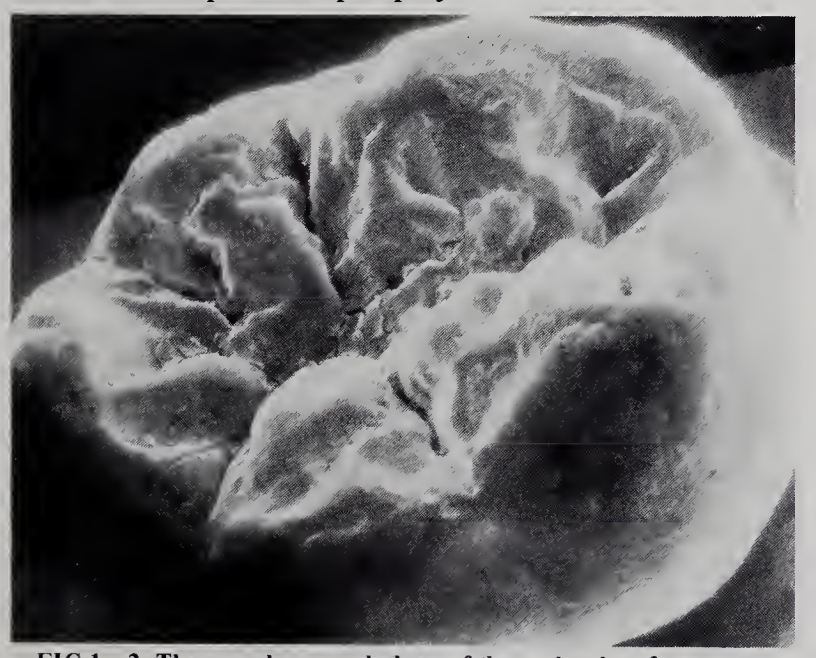


FIG 1—2 The complex morphology of the occlusal surfaces promotes the establishment of organic integuments on the enamel

Enamel is naturally porous. After the teeth erupt and are exposed to saliva, these pores become filled with organic or inorganic matter and are no longer patent. When a dental resin, such as a sealant, is applied to an enamel surface that has been cleaned but not otherwise treated, the resin will spread over the surface, but will not penetrate into it.

All commercial sealants are supplied with a phosphoric acid etchant. The concentration of acid ranges from approximately 35 to 50 percent. Immediately before sealing, the enamel surface is modified or "conditioned" by treating it with the phosphoric acid. Conditioning for one minute increases the enamel surface area by increasing the size and volume of enamel pores. Enamel mineral is removed both from the surface and within the surface to a depth of approximately 25 microns. Clinically, the surface appears dull and frosted compared with the translucence of normal enamel. While histological differences in the depth and quality of the etch have been reported with different phosphoric acid concentrations, there is no apparent difference in the clinical performance of sealants related to the various phosphoric acid concentrations supplied by the sealant manufacturers.

Different histologic patterns are produced on the enamel surface by the acid conditioning. These patterns, which are caused by a preferential etching of the ends of the enamel prisms at the surface of the tooth, are seen in Figures I—3 and I—4. Clinically, it is not possible to distinguish between the types of etching patterns. An amorphous etch associated with prismless enamel can also occur

Demineralization patterns of the enamel surface following phosphoric acid conditioning. SEM x 5,000

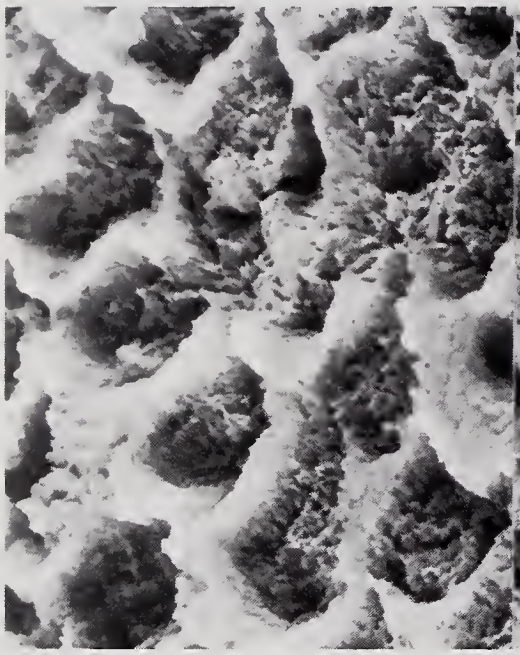


FIG 1—3
Prism centers mainly involved

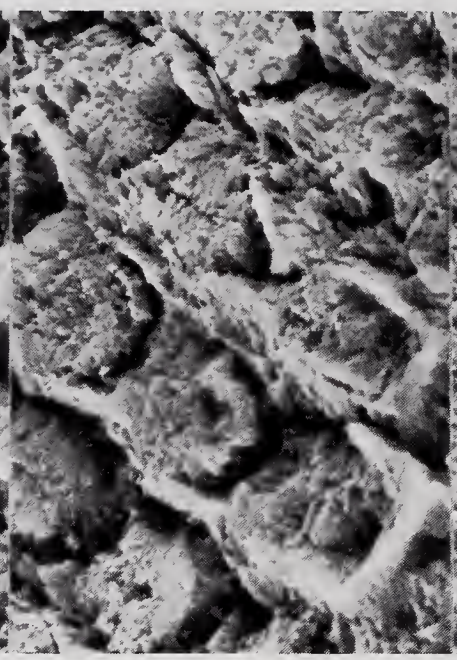


FIG 1—4
Prism peripheries mainly involved

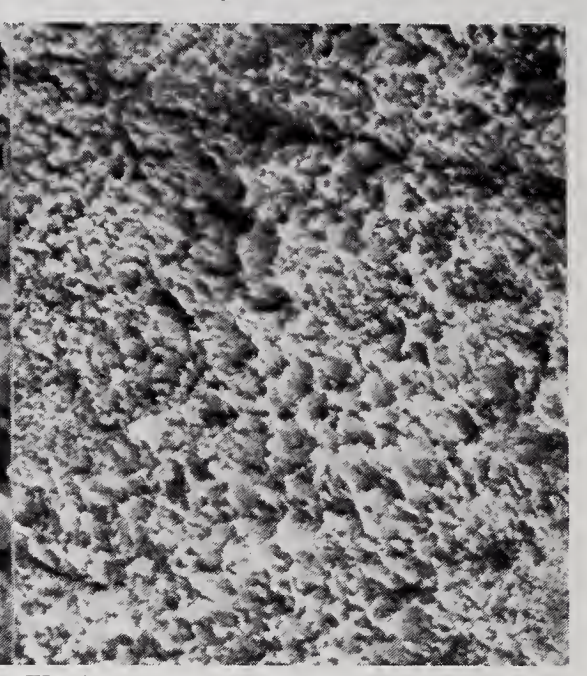


FIG 1—5
Amorphous pattern associated with prismless enamel

(Fig. I—5). This pattern most often has been identified with the primary teeth. Since retention of sealants is similar on primary and permanent teeth, this histologic feature does not appear to have adverse clinical implications when sealants are applied to occlusal surfaces.

A sealant placed over an acid conditioned surface spreads over the surface and penetrates into it, filling the micropores created by the acid etching procedure (Fig. I—6). After the liquid monomer penetrates the surface, it hardens. With autopolymerized sealants, polymerization is automatic; with light initiated sealants polymerization requires the application of the light source. The tags of hardened resin extend into the enamel surface like the bristles of a hairbrush (Fig. I—7). They hold the resin firmly in place and are responsible for clinical retention and success of the sealant.

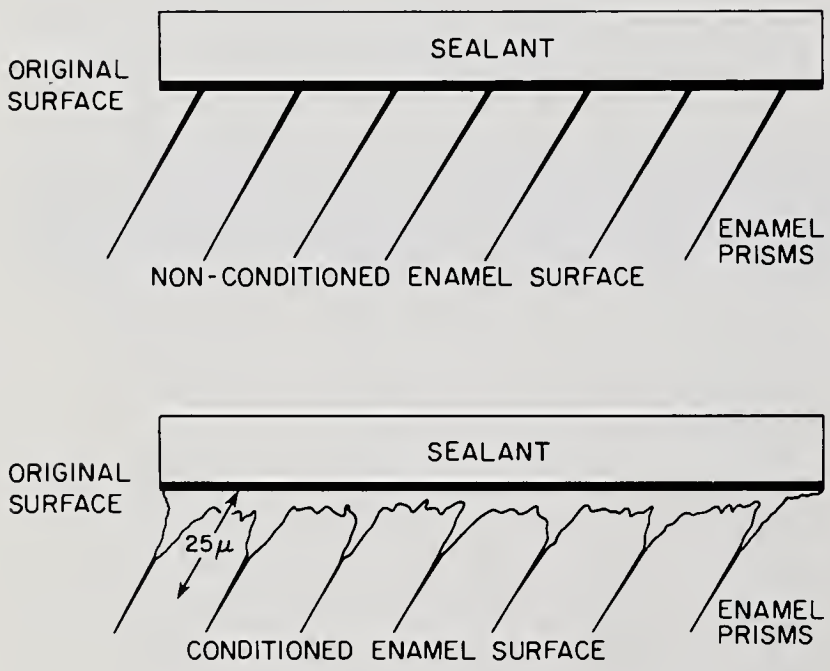


FIG 1—6 **Microscopic sealant tags extend into the surface of acid conditioned enamel but do not penetrate the nonconditioned surface.**

Once etched, the enamel surface is ready for bonding and nothing must be allowed to contaminate it until the sealant has been applied. Saliva is the major source of contamination of the etched surface that leads to failure. Salivary proteins quickly adhere to etched enamel. They physically occlude the micropores created by the etching procedure and interfere with penetration of the sealant monomer into the etched surface. Resin tags produced on saliva contaminated acid etched surfaces are small or nonexistent, and the bond strength between sealant and enamel is reduced significantly (Fig. I—8).

Hormati and co-workers verified the importance of a contaminant-free enamel surface for bonding.[18] Not only did they show that bond strength was reduced when resin was applied to a wet saliva contaminated surface, but they also showed that surfaces that were dried with air after being contaminated continued to have lower bond strengths. They recommended that saliva contaminated surfaces be re-etched for ten seconds.

FIG 1—7 Polymerized sealant tags extend into acid conditioned enamel providing microscopic bonding between the sealant and tooth. SEM x 3,000

FIG 1—8 Short, blunt sealant tags due to salivary contamination of the acid conditioned enamel surface. SEM x 3,000

Another source of contamination that can affect the clinical outcome of sealant treatment is the presence of microscopic calcium phosphate reaction products resulting from the interaction of the phosphoric acid conditioning agent and the enamel surface. These products are water soluble and, therefore, can be removed by a thorough washing after the acid conditioning step. Washing times after etching of from 10 to 15 seconds are recommended. If gels are used, a 30 second wash should be done in order to remove the gel which penetrates the enamel during etching.

The presence of fluoride is another potential source of contamination during the sealant procedure. It is imperative that topical fluoride not be applied between the etching step and sealant placement. The topical fluoride and conditioned enamel surface form globular reaction products, presumably soluble calcium fluoride, which adhere to the enamel surface blocking the micropores (Fig. I—9). The presence of these products lowers the bond strength between the sealant and enamel surface, resulting in clinical failure. The application of topical fluoride before the acid conditioning step does not appear to interfere with bonding. Nevertheless, it is prudent when doing both procedures at the same visit to apply the sealants first and do the topical fluoride treatment last.

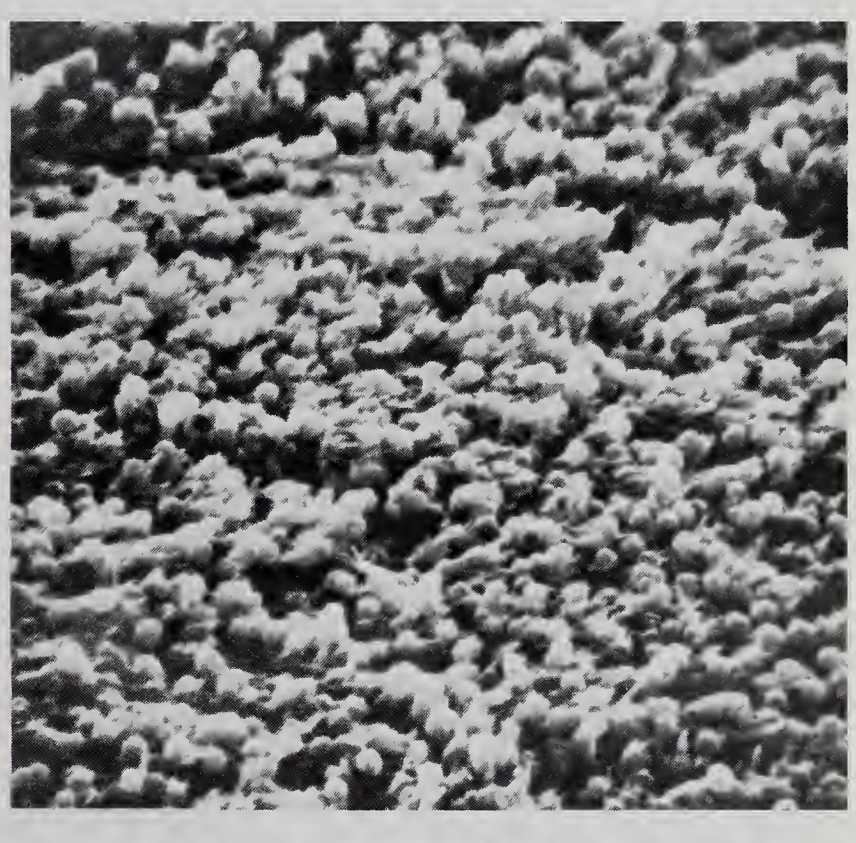


FIG 1—9 Contaminating calcium fluoride globuli following treatment of acid conditioned enamel surface with topical fluoride. SEM x 5,000.

SAFETY CONSIDERATIONS

Several concerns about the safety of sealants have been expressed. These concerns are diverse and address issues of systemic toxicity, eye safety, and local hard and soft tissue effects.

Systemic Toxicity

Sealants are within the voluntary control of the American Dental Association's Acceptance Program. A requirement for acceptance is that the product be safe. The basic components of fissure sealants are the same as those used in the resin portion of composite restorations. These have received certification by the ADA's program that includes standards for toxicity.

Bowen and co-workers have stated that systemic effects of a general nature from pit and fissure sealants are "improbable," and they know of no test results that cast doubts regarding the safety of available sealant resin formulations.[19]

Eye Safety

Visible light cured sealants are the most commonly used photoinitiated system. Visible light wave lengths are from 400-750 nanometers (nm). The visible light curing units are designed to filter all components of visible light except blue, which is emitted in a range of 400-500 nm. Since the light source is generating a component within the visible light spectrum, it is easy to assume, *incorrectly*, that the light is safe. Blue light acts on the eye to produce products called "free radicals" whose reactions with cells are harmful to vision. The American Dental Association has stated: "Although there is little information on the effects of high intensity visible light radiation on the eyes of dental personnel associated with the use of these photoactivating light units, there is growing concern about the potential for retinal photochemical injury from chronic exposure to emitted blue light."[20]

To reduce long-term risks to the eyes, when using photoinitiating light units operators and assistants must protect their eyes. Protective lenses are available in clip-on and frame styles (see Appendix). Since the lenses will cut off electromagnetic radiation below the 450-525 nm wavelengths,[21,22] the same lens will protect the eyes from both blue light and ultraviolet light radiation if an ultraviolet light sealant system is being used.

Phosphoric Acid Effects

The conditioning solution will remove about 5 to 10 microns of surface enamel. This amount is equivalent to that abraded away during a routine polishing with a dental prophylaxis paste. Other then this minimal loss of surface enamel, which is of no clinical significance, there is no deleterious effect to enamel, dentin, or pulp. No local gingival reactions from phosphoric acid have been reported, although accidental contamination during the countless number of times that sealants have been applied during the last twenty years must have occurred.

Effect on Occlusion

Occlusal disharmonies or TMJ problems from sealants have not been reported. The sealant application initially may cause an occlusal interference. However, sealants are not abrasion resistant. Excess is quickly worn away during mastication, usually within a few days, and proper occlusion is reestablished. Jensen and co-workers found that approximately 50 percent of a sealant's volume is lost one month after placement. The loss was similar for filled and unfilled resins. They stated that "the primary accommodation of the oral apparatus to sealant placement is wear of the sealant."[10]

Sealing Bacteria

Trapping bacteria beneath sealants is inevitable. Also, inadvertent sealing of initial carious lesions can occur. Neither of these events enhances the chance of caries developing or progressing beneath the sealant.

The ability of bacteria to survive under sealants is considerably impaired because ingested carbohydrates cannot reach them. Several investigators have found that the number of bacteria in sealed carious lesions decreases dramatically with time (Table I—8). Radiographs of frank occlusal lesions that were deliberately sealed for investigational purposes failed to show lesion enlargement several years after being sealed. These findings demonstrate not only that caries will not progress beneath a properly placed sealant but also that a lesion that is inadvertently sealed will arrest.

TABLE I—8

Effect of Sealing on the Microflora of Occlusal Lesions in Human Teeth

Study	Duration	Sample Size	Results
Handelman et al (1976)	6 months	8	200-fold decrease in bacterial count
	12 months	12	1000-fold decrease in bacterial count
	24 months	6	2000-fold decrease in bacterial count
Going et al (1978)	5 years	18	100-fold decrease in bacterial count
Mertz-Fairhurst et al (1979)	12 months	4	No growth in sealed sample
Jensen & Handelman (1980)	12 months	9	100-fold decrease in bacterial count

Sealant Loss

As long as the sealant is in place, the tooth surface is protected against caries. Protection is reduced or lost when a partial or total loss of sealant occurs, respectively. However, clinical studies have shown that teeth that have lost sealants are no more susceptible to decay than teeth that were never sealed.

PUBLIC INFORMATION ABOUT SEALANTS

Many precedents exist for educating the public about products and procedures that are important for health. Information about prescription drugs, cancer and blood pressure screening examinations, proper dietary habits, the effects of smoking and alcohol, the need for regular exercise, and the judicious use of radiographs have been the subjects of public educational campaigns. These programs have been mounted by government agencies, health and health related organizations, and medical and dental societies, all of whom have recognized the need for the public to be fully informed about procedures that protect health.

The public should be informed similarly about sealants. Yet, in 1984, approximately fifteen years after the first provisional acceptance of a pit and fissure sealant by the American Dental Association, Frazier warned that "the public, as consumers of and ultimate purchasers of dental care, has little if any knowledge of the availability and efficacy of sealants."[23] An uninformed public cannot create a demand for a procedure nor can it make an informed decision concerning its use. Health professionals, whether in private practice or participating in community programs, must educate the public about the value of sealants. To help in this effort, brochures and pamphlets on sealants have been produced by several sources (see Appendix). An educated public will be aware of the existence of sealants and their value, and can make informed decisions concerning their use for themselves and their children.

SECTION II
TECHNIC OF SEALANT APPLICATION

CONTENTS

INTRODUCTION

Sealants contain no active therapeutic agents. Caries prevention is achieved by physically occluding the orifices of the pits and fissures so that bacteria and food particles cannot combine to create the acids that demineralize the tooth. Success with sealants is dependent upon the formation of strong bonds between the sealant and the enamel surface enabling the sealant to remain firmly adherent to the tooth. Since resin attachment depends on the care taken during the application procedure, *the technic of the operator is the principal variable responsible for success or failure.*

Many commercial sealants are available. It is imperative that the directions of the manufacturer of the particular sealant chosen be observed when placing the sealant. Whether the sealant selected is autopolymerized or photoactivated, the principles involved in the application are the same and both depend upon the strict maintenance of a dry field.

The steps in the application of sealants are:

1. tooth selection;
2. prophylaxis;
3. isolation and drying;
4. acid conditioning;
5. washing and drying;
6. sealant placement; and
7. postapplication inspection.

SEALANT APPLICATION

Step 1: Tooth Selection

The occlusal surfaces of first and second primary molars, first and second premolars, and first, second and third permanent molars are all potential candidates for sealants (Fig. II—1). Sealants also should be considered where other pits and fissures exist; specifically, the lingual surfaces of maxillary permanent incisors, buccal surfaces of mandibular molars, and lingual surfaces of maxillary molars. Generally, sealants are indicated for children, but adults are also sealant candidates if they are judged to be at risk to pit and fissure decay.

The two important considerations when selecting teeth for sealants are:

1. the morphology of the pits and fissures should be deep; and
2. the teeth must be sufficiently erupted so that a dry field can be maintained.

Detailed specifics of patient and tooth selection are presented in Sections III and IV of this guide.

FIG II-1 Tooth to be treated

Step 2: Prophylaxis

A mounted prophy brush or cup is used to clean the pits and fissures with an aqueous pumice slurry (Fig. II—2). Flour of pumice is recommended rather than hydrogen peroxide or commercial dental prophylaxis pastes containing coloring or flavoring agents, glycerine or fluoride that might interfere with the bonding procedure.

After the prophylaxis, the surface is thoroughly washed with a water spray. All residual pumice particles in the pits and fissures should be washed away or removed with an explorer tip.

FIG II—2 Prophylaxis

Step 3: Isolation and Drying

The patient should be positioned so that the treatment site is visible and accessible, and so that gravity does not cause a pooling of saliva around the treatment site or interfere with the sealant application. The patient's head can be tilted so that saliva pools on the opposite side of the mouth from the teeth being sealed. A saliva-ejector or high volume aspirator should always be used.

Isolation is achieved most effectively with a rubber dam. However, cotton rolls are more practical and, provided a meticulous procedure is used, teeth sealed using cotton roll isolation retain sealants as well as teeth isolated with a rubber dam (Fig. II—3). Saliva absorbers placed over the parotid duct openings, can be used in conjunction with cotton roll isolation.

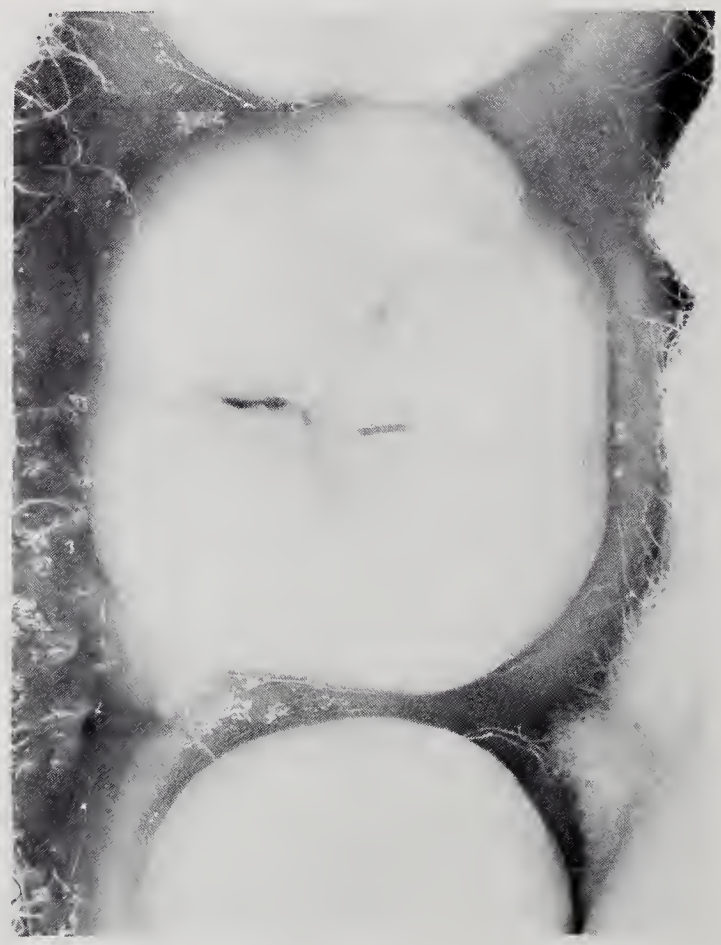


FIG II—3 Isolation with cotton rolls

Once the site has been isolated from salivary contamination it should be dried thoroughly with compressed air. The air line must be free of oil or moisture which will interfere with bonding. The air line can be checked by blowing air from the syringe onto the surface of a dental mirror. If streaks of water or oil droplets appear, the air line is contaminated and cannot be used for the sealant procedure.

Step 4: Acid Conditioning

The cleaned and dried surface is etched with phosphoric acid for 60 seconds. A small cotton pellet, minisponge, or brush can be used to apply the acid. A lockable cotton pliers facilitates holding the cotton or sponge. The surface to be sealed is kept moist with acid and not allowed to dry. If an acid gel is used, it is left undisturbed (Fig. II—4). If a solution is used a gentle dabbing motion is performed to keep the solution agitated. The enamel surface should not be rubbed or burnished with the applicator. Burnishing will smooth the enamel surface which has been made porous by etching, reduce the surface area being prepared for bonding, and adversely affect bond strength.

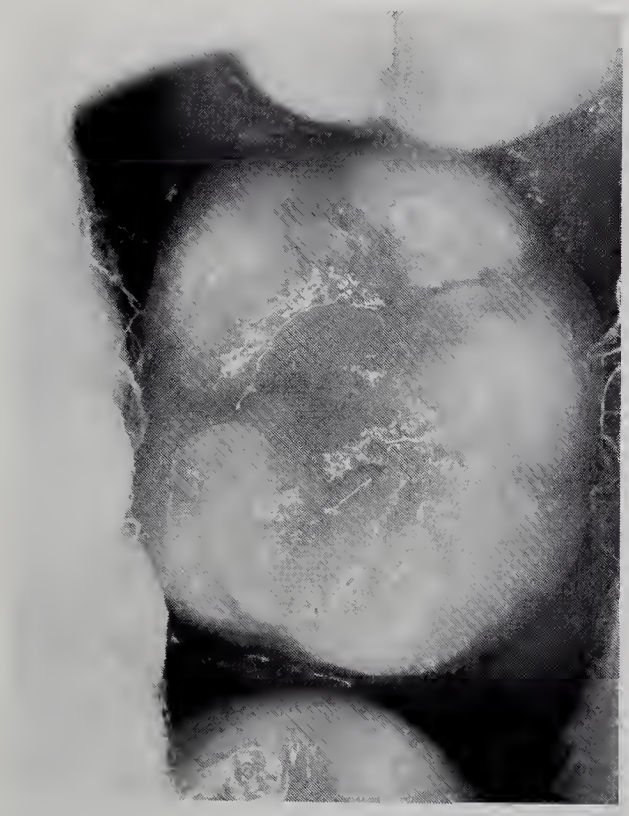


FIG II—4 Acid etch with gel

Step 5: Washing and Drying

The phosphoric acid and reaction products resulting from the chemical action of the acid with the enamel surface must be removed by washing. This is accomplished with water under pressure or an air-water spray (Fig. II—5) Washing must be thorough and be performed for at least 10 to 15 seconds when an acid solution is used. With gels, washing is done for at least 30 seconds. Although the gel is water soluble, because of its viscosity it takes a greater washing effort to remove it from the enamel porosites created by the etching procedure.

FIG II—5 Washing

Rapid evacuation should be used when washing the teeth and patients must never be allowed to rinse. The cotton rolls and saliva absorbers usually become saturated and need to be replaced. These should be changed quickly and in such a manner that the etched teeth do not become contaminated with saliva. Simonsen recommends placing new cotton rolls over the saturated ones before removing them from the mouth,[24] others leave the used cotton rolls beneath the new ones. If a cotton roll holder is used, a second loaded cotton roll holder should be positioned close to the patient's mouth. The used cotton roll holder should be removed and the new one quickly inserted before the patient's tongue, cheek or saliva contact the teeth.

After washing off the etchant solution, the surface is thoroughly dried with clean, uncontaminated compressed air. Care also must be taken to avoid blowing saliva onto etched surfaces.

Upon drying, a properly etched surface will have a dull matte or frosty appearance in contrast to the glossy appearance of unetched enamel (Fig. II—6). *At this critical point, salivary contamination must be avoided.* If saliva contacts the etched surface it will produce an adherent coating that will reduce bond strength. Even a few seconds' contamination of the enamel with saliva can result in a coating that masks the microporosites created by the etching procedure. Should salivary contamination occur, the surface must be washed, dried, re-etched with phosphoric acid for 10 seconds, and washed and dried again before proceeding to the sealant application step.

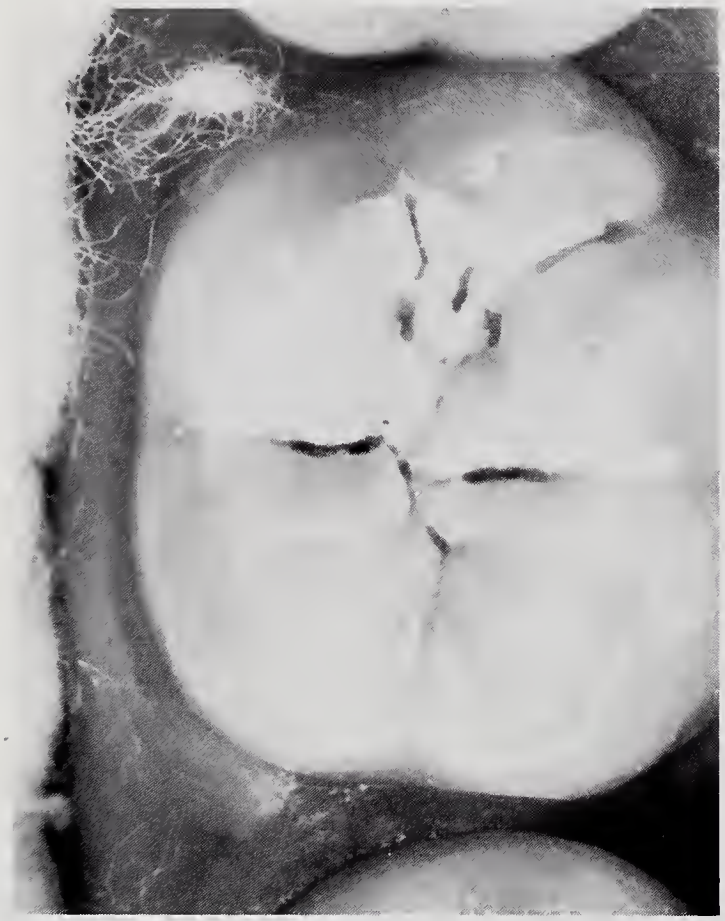


FIG II—6 Frosty appearance of etched enamel

Step 6: Sealant Placement

Since the application step will vary according to the product selected, the operator must follow carefully the manufacturer's instructions.

When an autopolymerized material is used, the liquid catalyst and base (sometimes called the universal) are mixed in a 1:1 ratio. A mix of two drops of each can be used for one molar and one premolar. If more than two teeth are being treated in a quadrant, separate mixes should be used since the working time of the sealant may elapse. Strict adherence to the timing, described in the manufacturer's instructions, is important. Three phases are critical: mixing time, working time, and setting time. Once thoroughly mixed, autopolymerized sealants have a short working time before the setting process increases their viscosity. As the sealant polymerizes and becomes more viscous it will not flow readily into the enamel micropores and weaker bond strengths will result.

Using the disposable brush or applicator provided by the manufacturer, the mixed sealant is flowed over the etched, dried surface (Fig. II—7). The sealant should extend from cusp to cusp, but should not cover the marginal ridges. It is better that too much rather than too little be applied. If more than one tooth in a quadrant is being sealed, the most posterior tooth should be treated first since maintaining dryness is more difficult in the back of the mouth.

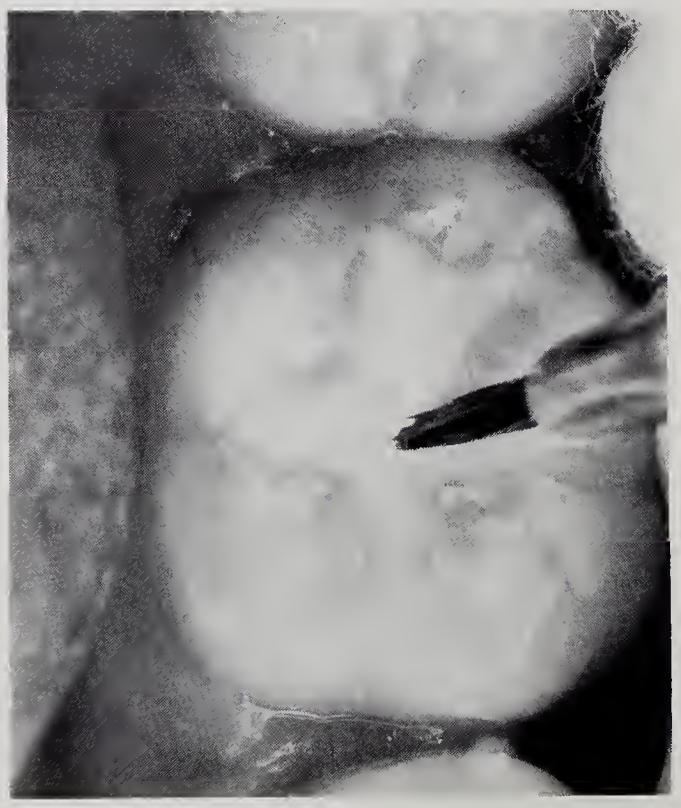


FIG II—7 Application of sealant

Photoinitiated sealants do not require mixing. The working time is adapted to the situation since the operator controls the initiation of polymerization. Sealant is applied to the teeth using the applicator provided. Some sealant brands may be applied directly from the bottle to the prepared surface with a cannula. After the sealant has been placed,it is initiated with the appropriate light source. For the first few seconds of polymerization, the tip of the light should be held approximately 2 mm. from the sealant surface so that it does not become coated with sealant. Each tooth surface being sealed must be exposed to the curing light for the amount of time indicated by the manufacturer. If the surface to be sealed is larger than the tip of the curing rod, the tip should be moved across the sealant surface. Each section of the sealant must be cured before advancing the tip along the surface. This procedure will increase the time to polymerize the sealant.

A flap of gingival tissue on the distal marginal ridge of a molar tooth will interfere with sealant application. The patient may be rescheduled to allow for further eruption of the tooth. If the dentist feels occlusal caries is imminent and that it is not prudent to delay treatment, the tissue must be retracted. The assistant may retract the tissue with a flat bladed instrument. This method, however, is cumbersome and engages the assistant during much of the application procedure. A rubber dam may be used to retract the tissue by clamping the tooth being treated and slipping the dam between the tissue flap and tooth, or a metal matrix band, such as a Caulk AutoMatrix, may be placed around the tooth and serve to block the gingival tissue.

Step 7: Postapplication Inspection

Isolation of the teeth should be maintained until inspection of the sealant reveals no deficiencies.

The teeth are inspected visually and with an explorer after polymerization has occurred (Fig. II—8). Setting time will vary according to the sealant used. With some autopolymerized sealants, the sealant left in the mixing tray can be tested with an explorer. If the sealant in the tray is hard, it is also hard in the mouth.

FIG II—8 Postapplication inspection

If coverage of the pits or fissures is incomplete, or if there is a surface air bubble, more sealant can be applied if the tooth has remained uncontaminated. Otherwise the tooth must be re-etched for 10 seconds, washed and dried before adding additional sealant.

A thin surface film of sealant will remain unpolymerized because of contact with air. This film has an unpleasant taste and should be wiped off with a wet cotton roll. The isolation materials can then be removed and the patient allowed to rinse.

If an unfilled sealant is used, the patient should be informed that it may feel "high" but will be worn down in the next few days by the patient's own occlusion. If a sealant containing filler particles is used, occlusion should be checked with articulating paper and occlusal interferences removed from the sealant with a finishing bur.

RECALL

The greater rate of sealant loss occurs within the first twelve months after application. Therefore, sealed teeth should be evaluated within a year of treatment. The dried teeth should receive a visual-tactile examination using a mirror and explorer. All vulnerable pits and fissures must be checked for sealant coverage.

The recall status of a sealed tooth will fall into one of the categories listed in Table II-1. If reapplication of sealant is required, the tooth should be treated as outlined in Steps 2 to 7.

TABLE II—1

Status and Treatment of Sealed Surfaces Upon Recall

Recall Status of Tooth	Treatment
All pits and fissures covered	No treatment required
Sealant missing from some or all of the pits and fissures; exposed surface sound	Reseal the exposed pits and fissures
Sealant missing from some or all of the pits and fissures; frank caries present	Restore carious pits and fissures

SECTION III
SEALANT USE IN INDIVIDUAL OFFICE PROGRAMS

CONTENTS

INTRODUCTION

Comprehensive treatment plans for individual patients should consider the need for sealants. The occlusal surfaces of first and second primary molars, first and second premolars, and first, second, and third permanent molars are all potential sites for sealing. Buccal pits on mandibular molars, lingual grooves on maxillary molars, and lingual pits on maxillary incisors should also be considered for sealing. The majority of sealants will be placed in children and adolescents. However, if adults are developing lesions in pits and fissures that were previously caries free, sealants should be applied to those pit and fissure surfaces that have not yet developed caries.

Ideally, patients receiving sealants should be on some type of fluoride program to reduce the risk of smooth surface caries. Dentists can give topical fluoride treatments in their offices, recommend the home use of fluoride mouthrinses or prescribe dietary fluoride supplements, as indicated, if a community is fluoride deficient. Brushing with a fluoride dentifrice should be standard and should always be encouraged. Because of the many ways in which patients can receive fluoride, the absence of optimal levels of fluoride in the drinking water is not a contraindication to the use of sealants.

CARIES DIAGNOSIS

Before a decision to use sealants can be made, a caries diagnosis must be performed. A diagnosis of caries in pits and fissures is based upon a visual-tactile examination of the air dried tooth using a mirror and sharp explorer. A diagnosis of caries on proximal surfaces usually includes an evaluation of bite-wing radiographs. However, if the tooth being sealed is newly erupted, it can be assumed that the proximal surfaces are caries free and a decision to use sealants can be made without performing a radiographic diagnosis.

Table III—1 presents criteria that should be used when evaluating a tooth's caries status.

TABLE III—1

Caries Diagnostic Criteria

Caries Type and Surface	Frank Lesions	Lesions Not Showing Frank Cavitation
Pit and Fissure Lesions on Occlusal, Facial, or Lingual Surfaces	Gross cavitation is recognized by a break in the enamel with softness and usually with discoloration.	These areas are considered carious when the explorer "catches" or resists removal after insertion into a pit or fissure with moderate to firm pressure, *and* when this is accompanied by one or more of the following: 1. softness at the base of the pit or fissure which can be penetrated by the explorer; 2. softened enamel on the wall of the pit or fissure which may be scraped away with the explorer; 3. a white halo of opacity surrounding the air-dried pit or fissure which indicates undermining demineralization
Smooth Surface Lesions on Proximal Surfaces	Gross cavitation is recognized by a break in the enamel with softness and usually with discoloration.	Surface is Exposed to Direct Visual and Tactile Examination. If a white spot is present, this is evidence that demineralization has occurred. The lesion may be active or arrested; however, to differentiate on the basis of surface softness could result in the destruction of an intact enamel surface, if the lesion is active. This destruction should be avoided. All white spots should be treated with an appropriate fluoride regimen in order to attempt remineralization. Surface is Hidden from Direct Visual and Tactile Examination. Unless the teeth are newly erupted, bite-wing radiographs should be available. A definite radiolucency involving the enamel surface is evidence of demineralization. If the lesion has not progressed beyond the dentino-enamel junction it should be treated with an appropriate fluoride regimen in order to attempt remineralization. Otherwise, it must be restored.

Questionable Surfaces

A questionable diagnosis is one in which the operator cannot make a definitive decision that the tooth is carious or sound. The explorer tip sticks in the tooth surface but other evidence of caries, such as softness at the tip of the explorer or a white halo of undermining demineralization is not present (see Table III—1). The "stickiness" may be caused by the explorer wedging between the sound walls of a narrow fissure.

INDICATIONS AND CONTRAINDICATIONS

In individual patient care programs, the decision to use sealants is based on an examination of the specific teeth involved plus some general considerations of the patient's oral status. Figure III—1 outlines the diagnostic steps required when deciding whether to place a sealant. As a result of the visual-tactile examination, the occlusal surface will be classified into one of three categories: *sound*, *questionable*, or *carious*. (Table III—2).

Sound Surfaces

The primary diagnostic criteria for a sound pit or fissure is that the enamel surface is hard and resistant to penetration by an explorer. If there is a

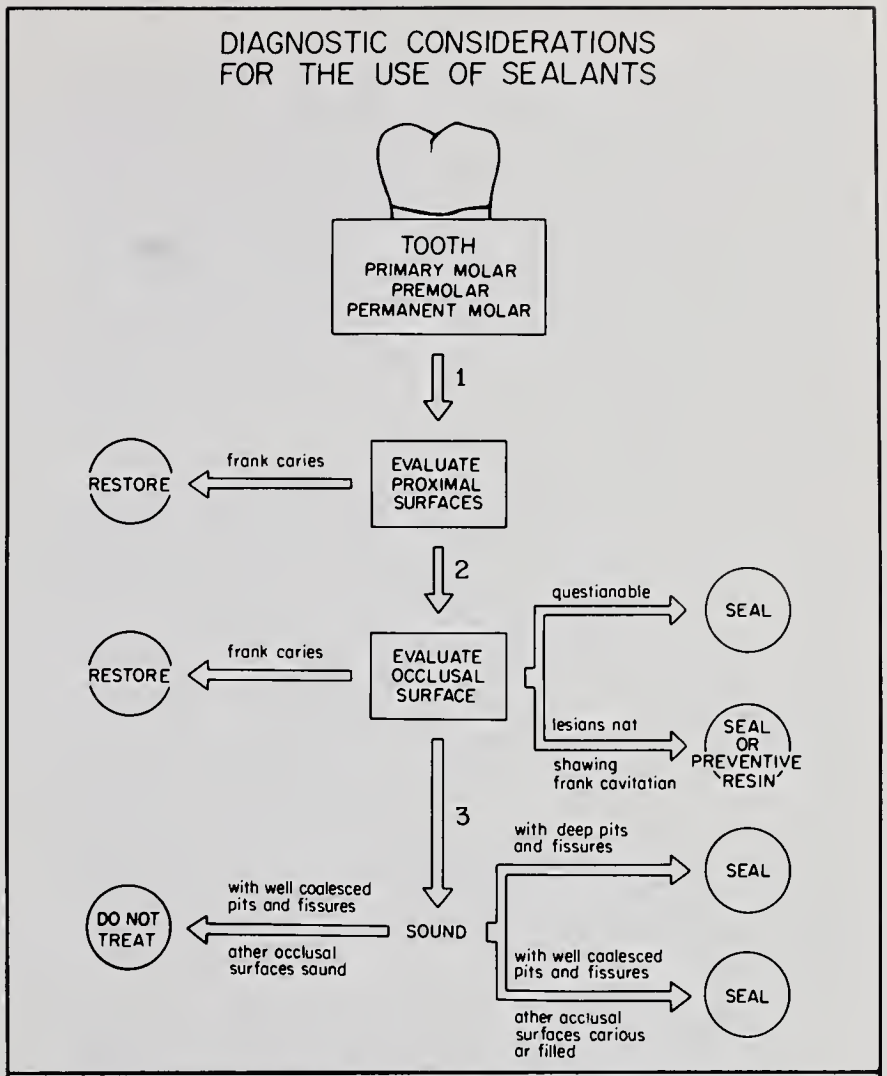


FIG III-1 **Diagnostic flow chart for all occlusal surfaces and for lingual grooves of maxillary molars that extend from the occlusal surface. Buccal pits of mandibular molars and lingual pits of maxillary molars enter chart at arrow number two. (Substitute the appropriate surface for "Occlusal"). When using the chart, it is assumed that the patient is receiving appropriate fluoride therapy.**

TABLE III—2

Tooth-Oriented Criteria for the Use of Pit and Fissure Sealants in Individual Care Programs

Diagnosis of Occlusal Surface	Clinical Considerations	Do Seal	Do Not Seal
Sound	occlusal morphology	deep, narrow pits and fissures	broad, well-coalesced pits and fissures
	status of proximal surface (s)	sound	frank caries
	general caries activity	many occlusal lesions, few proximal lesions	many proximal lesions*
Questionable	status of proximal surface (s)	sound	frank caries
	general caries activity	many occlusal lesions, few proximal lesions	many proximal lesions*
Carious	occlusal anatomy	if pits or fissures are separated by a transverse ridge, a sound pit or fissure may be sealed	pits or fissures with frank lesions

*unless other preventive measures are instituted

minute break in the integrity of the enamel surface, but the area is hard, the surface is considered to have an inactive or arrested lesion and is treated as sound. A sound or caries-free surface *may* be sealed, based principally upon considerations of occlusal morphology and caries risk, but also including tooth age, and the pattern of caries activity in the mouth.

Occlusal Morphology

Occlusal morphology is one indication of caries risk. Teeth with deep, narrow pits and fissures that are difficult to clean should be sealed. Teeth with well coalesced pits and fissures and wide, easily cleaned grooves usually do not require sealing. Premolars are much less susceptible to occlusal caries than permanent molars. The reason probably relates to their smoother occlusal morphology. Using occlusal morphology as a guide, fewer premolars will be indicated for sealing than permanent molars.

There are also significant differences between the occlusal morphology of first and second primary molars. Frequently, first primary molars have a saucer-shaped occlusal surface without pits or fissures. Such surfaces need not be sealed. The occlusal surface of second primary molars resembles that of first permanent molars and the pits and fissures may be deep. In such cases, sealing is indicated.

Tooth Age

Tooth age has been another criterion for deciding whether a sound tooth should be sealed. If the occlusal morphology is judged to place it at a high risk to pit and fissure caries, the tooth should be sealed as soon as it is erupted sufficiently to allow adequate isolation for the sealant procedure. In order to seal primary molars early, not only must the crown height be favorable for isolation, but also the patient must be cooperative.

Maxillary molars with transverse ridges are exceptions to the general rule concerning the need for complete eruption. Sometimes, it is possible to seal the mesial pit of a partially erupted maxillary molar and, at a later visit, to seal the distal pit and lingual groove after further eruption occurs.

It has been stated that most occlusal caries on molar teeth occurs two to four years after eruption. Thus, it has been recommended that molars that have remained caries free for four years or longer need not be sealed, because it is unlikely that they will develop occlusal caries.[11,26] However, the statement on posteruptive tooth age relative to caries risk was made in 1965 when both the caries prevalence and pattern was different than it is now. Anecdotal comments persist from both caries researchers and clinicians that molar teeth are experiencing occlusal caries after the so-called four year posteruptive highest caries-risk period. While some believe that the duration of risk to occlusal caries has been prolonged in today's children and adolescents, epidemiologic evidence is unavailable to support this belief. Although further study of the long term caries susceptibility of occlusal surfaces is needed, it is recommended that posteruptive age no longer be used as a major criterion for deciding whether a tooth should be sealed. The primary consideration should be the risk of the occlusal surface to caries.

Caries Pattern

If the principal caries attack in a patient involves the pits and fissures, it is imperative that the remaining caries free pit and fissure surfaces be sealed as soon as possible. If a patient has many proximal lesions, sealants may still be used on the occlusal surfaces of caries free teeth. However, proximal lesions that develop on sealant treated teeth require preparation of the occlusal surface, although it is caries free, in order to retain the restoration. It is important, therefore, that other caries preventive procedures, such as fluoride therapy, diet modification, and good oral hygiene habits be instituted in order to protect the proximal surfaces. In the future, operative procedures for proximal caries on posterior teeth may employ different technics, such as acid etch retained composite resins, so that proximal caries can be restored without destroying a sound occlusal surface.

Questionable Surfaces

Because a questionable surface has not been diagnosed as carious, a restoration is inappropriate. However, since the "sticky" area can easily trap bacteria and food particles, and since cleaning can be difficult, these surfaces should be considered to be at a heightened level of caries susceptibility. *A questionable surface is an ideal candidate for sealing.*[27] A sealant will prevent the surface

from advancing from a questionable status to one of definitive caries. This approach is justified since it has been shown that if a diagnostic error occurs and caries is inadvertently sealed, the lesion will not progress but, instead, should arrest (see Table I—8).

Carious Surfaces

Frank caries, described in Table III—1, is easily recognized. An occlusal surface with definite caries should have the caries removed and restored. It is not a candidate for sealing. The restoration may be an amalgam or posterior composite. When the caries is minimal and limited to a single pit or groove, a preventive resin restoration should be considered.[28,29] This treatment involves removing the carious area only, filling the cleaned cavity with composite, and then placing a sealant over the composite filling and the remaining caries free pits and fissures.

There is an exception to the general rule that a carious occlusal surface should not receive a sealant, namely, when discrete pits or fissures are separated by an intact transverse ridge. This situation occurs in maxillary second primary molars, maxillary permanent molars, and mandibular first premolars. If one pit or fissure is carious and the other sound, the sound area should be sealed.

DETAILS OF AN OFFICE SEALANT PROGRAM

Patient Education

There are many patient education materials that help inform parents about the nature, safety and effectiveness of sealants. These are available from the American Dental Association, the American Society of Dentistry for Children, the National Institute of Dental Research, and from sealant manufacturers. The materials include pamphlets, posters and wall plaques, and a film and videocassette (see Appendix). Articles about sealants sometimes are published in newspapers and magazines. These should be clipped and saved for parents. Reading favorable articles on sealants can help establish sealant credibility.

The educational materials can be used effectively with a chairside demonstration of pits and fissures. Parents can be shown the caries prone areas in their own children's teeth, or alternatively can be shown the pit and fissure areas on orthodontically extracted teeth, premolars and third molars, which have been mounted on a wax block. The same block also can contain sealant treated teeth. With these aids, the atraumatic nature of sealant therapy should be explained. Sealants, unlike restorative procedures, do not involve anesthesia or tooth preparation. At the same time it should be stressed that sealants are a proven caries preventive procedure which has received the endorsement of the Surgeon General of the United States as well as many dental organizations (see Appendix). The preventive nature of the procedure, the noninvasive technic, and the ultimate savings in time and money are all positive features of a sealant presentation.

Children can be prepared for their sealant visit by being shown the mounted untreated and treated teeth and by observing other children while they are receiving sealants. Some of the patient education materials listed in the Appendix are intended for children. They explain in a manner that children can understand why the chewing surfaces need sealants.

It is important to inform both parents and children that sealants are one part of a total caries preventive program. For optimal caries control, their compliance in a program that also includes the use of fluorides, proper dietary habits, and good oral hygiene is essential.

Choice of Sealant

The different types of commercial sealants are described in Section I. Numerous controlled clinical trials have demonstrated the long term effectiveness of autopolymerized sealants and a number of them have been classified as Acceptable in the American Dental Association's voluntary review program. Several visible light cured systems have also been classified as Acceptable or Provisionally Acceptable, which means that data on the safety and effectiveness of these newest sealant products have been reviewed by the American Dental Association (see list in Appendix).

Because a partially filled sealant offers no advantage and has the disadvantage of requiring occlusal equilibration at the application visit, an unfilled sealant is usually preferred. The presence

of tinters or opaquers in the sealant provide better visibility for the operator at the initial and recall visits; however, whether a colored, opaque, or clear sealant is used is a matter of personal choice.

Commercial sealants also differ in their acid conditioning agent. The concentration of phosphoric acid varies from approximately 35 to 50 percent and the agent may be supplied as a liquid or gel. Since there is no evidence that the clinical performance of the sealant is affected within the range of phosphoric acid concentrations available, this need not be a factor in selecting a sealant. Gels will stay where they are placed on a tooth. This is advantageous when the system is also being used for other acid etch procedures such as direct bonding of orthodontic brackets, fracture repair, and cosmetic bonding where gravity flow is often a problem. If a gel is used as the etching agent, extra time should be allowed when washing it off the tooth (see Section II).

Working Without an Assistant

Ideally, sealants should be applied by an operator-assistant team. When this is not possible, the critical concern is the maintenance of a dry field and the avoidance of contamination of the etched surfaces by saliva. When working without an assistant the best method of retracting tissue and maintaining a dry field is the use of a rubber dam. A second choice is the use of a cotton roll holder/retraction system, such as the Automaton cotton roll holder,which retracts as well as isolates.

Sequence of Sealant and Topical Fluoride Application

If a patient's treatment plan includes sealants and a professional topical fluoride application, the sequence of treatment is of no concern if the two procedures are performed at different visits. If they are done at the same visit, sealant application should be completed before the topical fluoride treatment. This sequence assures that the fluoride treatment does not adversely affect the retention of the sealant and provides fluoride to any etched but unsealed areas of the teeth.

Recall

After the initial application, the sealant should be checked periodically. The greatest sealant failure rate occurs within the first year because of flaws in the application procedure. Since most dental offices have a six or 12 months recall schedule, posttreatment sealant checks should become part of the office recall routine. At the recall visit, the treated tooth should be examined for sealant coverage and for the marginal integrity of the sealant-enamel bond. In addition to checking treated teeth, newly erupted teeth should be considered for sealant therapy.

As seen in Table I—5, when autopolymerized sealants are used, the occlusal surfaces of more than 60 percent of treated teeth should still have sealant completely covering the pit and fissure areas five or more years after application. If a tooth has lost all or part of its sealant and is still caries free, a new application should be made.

Fees

Table III-3 lists the range of fees for sealants charged by general practitioners and selected specialists in the United States, based upon a 1982 American Dental Association survey.[30] The average fees were $11.14 per tooth and $27.77 per quadrant. As seen in the table, the range of fees charged by practitioners was quite wide. While office cost accounting methods will determine the fee charged by a particular office, the following generalizations should be considered:

1. Fees should be assessed on a per tooth or per quadrant basis. Since it takes less time to treat several teeth in the same quadrant than to treat them individually, the per quadrant fee should be less than the sum of the fees if the teeth were treated individually.
2. Lingual grooves on maxillary molars are extensions of the disto-occlusal groove. There should be no additional charge to treat a lingual groove when treating the occlusal surface.
3. Buccal pits usually are separate from the occlusal surface. Nevertheless, consideration should be given to include buccal pit sealant application in the same fee as the occlusal surface.
4. There should be no difference in fees for primary teeth, premolars, or permanent molars.
5. There should be no charge for reapplication of sealants lost or partially lost within a three year period.

TABLE III—3

Sealant Fees Charged by Private Practitioners, 1982

	Mean	Mode	Percentiles 10	50	95
Fee per tooth	$11.14	10	5	10	25
Fee per quadrant	27.77	20	10	25	60

Source: Bureau of Economic and Behavioral Research, JADA 1984

A principal determinant of a sealant fee structure is the reimbursement level of the operator who performs the service. Since dental auxiliaries' time is reimbursed at a lower rate than dentists' time, delegating this procedure reduces its cost. The American Dental Association has stated that the application of sealants can be performed by trained auxiliaries[31] and an American Dental Association sponsored conference on sealants concluded that sealants are cost effective "especially if applied by auxiliaries."[32] Currently, the dental practice acts of more than 30 states allow dental hygienists and/or dental assistants to apply sealants.

The cost of sealant treatment includes not only the initial service but also replacement, if necessary. Office costs for sealants can be minimized by following these guidelines:

1. delegating sealant treatment to auxiliary personnel where legally permitted;
2. selecting commercial products that have the most favorable retention rates; and
3. following a meticulous application procedure to maximize the longevity of the sealants and minimize the number of reapplications.

SECTION IV
SEALANT USE IN COMMUNITY PROGRAMS

CONTENTS

INTRODUCTION

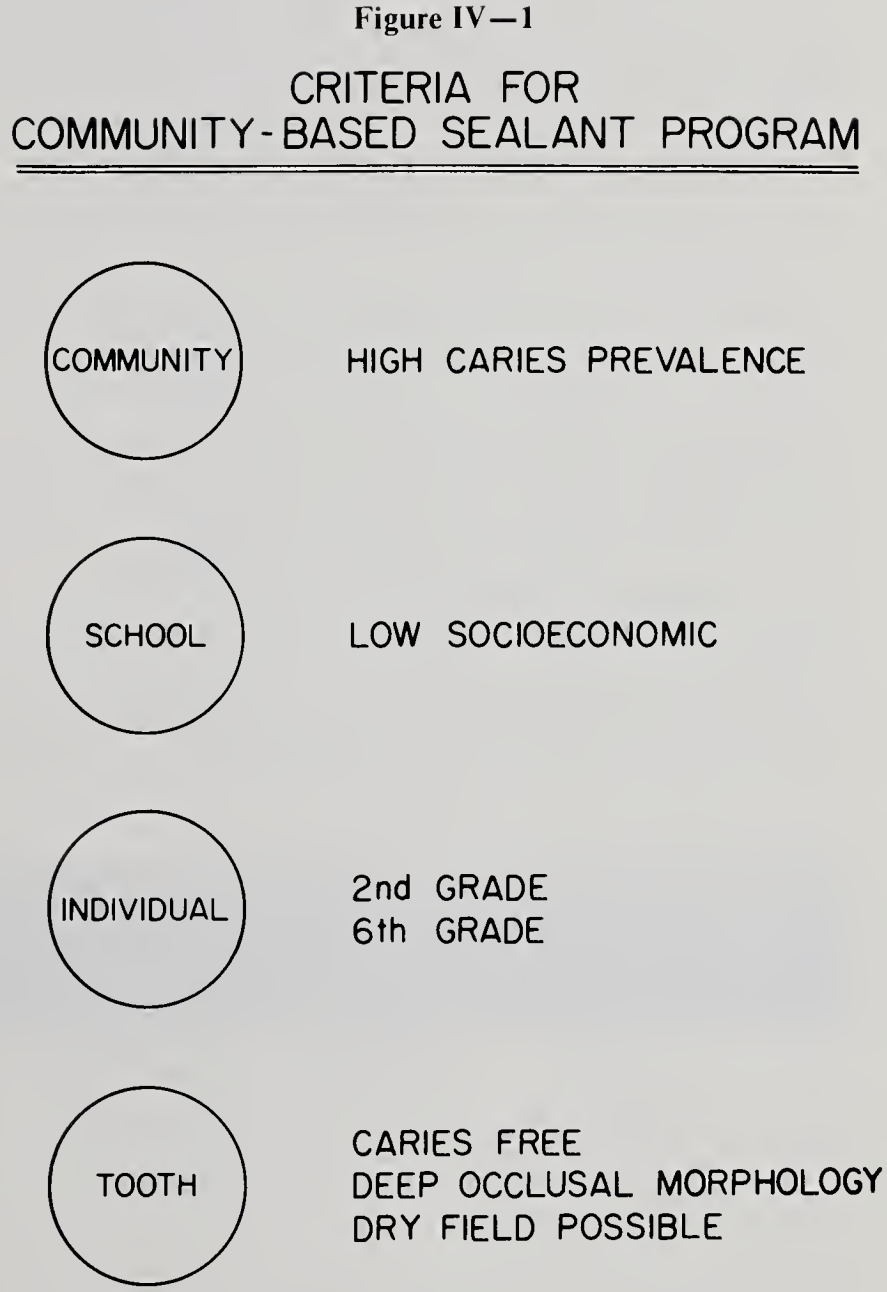
Many communities in the United States have operated school-based preventive dentistry programs for years. These programs have included fluoride mouthrinses, fluoride tablets, operator applied topical fluoride, school water fluoridation, prophylaxes, and dental health education. Because of the current decline in dental caries prevalence and the shift in the disease pattern in children to one in which primarily the pit and fissure surfaces are involved, sealants have become both desirable and practical for community preventive dentistry programs. Sealant applications can be included in ongoing programs or can be started in communities where a preventive program currently does not exist.

Generally, the responsibility for planning, funding and implementing a preventive dental health program lies within the city/town, county, or state health department. Ideally the program is developed and conducted by dental personnel with dental public health training. This section provides general guidelines for the initiation and maintenance of community sponsored, school-based sealant programs. Particular operational details, however, should be tailored to conform to the needs of the individual community in which the sealant program is located.

CRITERIA FOR PARTICIPANT SELECTION

For the selection of a population to receive sealants, criteria must be established at four levels: 1) community, 2) school, 3) individual, and 4) tooth. (Fig. IV-1).

Figure IV—1



Community Oriented Criteria

Communities with high caries activity receive the greatest benefits from a preventive program. Since caries prevalence in the United States varies on a state and regional basis, high caries activity in one section of the country may be considered low in another. Thus, the identification of communities for sealants must be based on local rather than national standards of caries prevalence.

Table IV-1 presents the caries prevalence of school children recorded in the 1979-80 National Dental Caries Prevalence Survey.[5] These figures indicate the average caries activity, by region, in the United States. In the absence of more local or current information, they provide one standard by which to judge the caries prevalence of individual communities. Nevertheless, it is important that the director of a sealant program identify the dental needs of the children in the particular community involved.

In communities with high caries levels, dual programs that include both fluorides and sealants should be considered. If community water fluoridation is not feasible, a school-based fluoride program should be instituted. However, although disease levels are higher in fluoride deficient communities compared to those that are fluoridated, the pattern of decay on the different tooth surfaces is similar (see Table I—3). Therefore, the inability to mount a fluoride program should not preclude the initiation of a sealant program alone.

School Oriented Criteria

Once a community is targeted for a sealant program, the next selection level is to identify the schools that are to be included in the program. The same selection principle, identifying high risk populations, also should be followed at this level. Within communities, schools with the highest caries prevalence are those that primarily have children from low socioeconomic families.[8] These schools can often be identified by the high percentage of children on subsidized lunch programs. In the absence of specific dental criteria, therefore, socioeconomic status can be used to predict the relative level of caries prevalence.

Individual Oriented Criteria

A convenient method to identify children for a sealant program is by their grade level. The goal of a sealant program in school age children is to treat new permanent teeth as soon as they are sufficiently erupted to enable proper isolation and before the pits and fissures become carious. Thus,

TABLE IV—1

Caries Prevalence (DMFS) in United States School Children by Geographic Region

Age (Yrs)	REGION I CT, ME, MA NH, RI, VT	REGION II NJ, NY, PA	REGION III IL, IN, IA MI, MN, MO OH, WI	REGION IV AL, AR, DE FL, GA, KY LA, MD, MS NC, SC, TN VA, WV	REGION V AZ, CO, NM TX,	REGION VI ID, KS, MT NB, NV, ND OK, SD, UT WY	REGION VII CA, OR, WA
5	0.21	0.15	0.12	0.07	0.11	0.07	0.15
6	0.32	0.32	0.19	0.19	0.12	0.16	0.12
7	0.64	0.61	0.61	0.49	0.49	0.60	0.71
8	1.93	1.23	1.42	0.95	1.13	1.29	1.30
9	2.04	2.05	2.15	1.78	1.36	1.69	1.92
10	3.17	2.74	2.73	2.44	1.90	2.23	2.91
11	4.38	2.91	2.98	2.79	2.40	3.52	3.19
12	6.05	4.45	3.87	4.07	3.38	3.90	4.50
13	6.56	5.76	5.58	5.34	3.87	5.36	5.38
14	7.98	6.76	6.37	6.69	5.25	6.01	6.74
15	9.76	9.05	7.94	8.09	6.00	7.38	8.07
16	11.79	10.97	8.93	9.42	7.26	8.08	10.80
17	13.48	13.87	10.46	10.27	6.57	10.74	12.33
All	6.05	5.39	4.67	4.60	3.41	4.43	5.12

(Does not include Alaska or Hawaii)

Source: The Prevalence of Dental Caries in United States Children, 1979 - 1980.

the key indicator of the selection process at this level is the eruption status of the teeth to be sealed. Tooth eruption can be related to the children's age, which is generally associated with their grade level.

Occlusal surfaces, especially those of molars, can begin to develop decay soon after they erupt. In designing a sealant program, a compromise must be reached concerning when the teeth should be sealed. If they are sealed too soon after eruption, proper isolation may not be possible and the treatment will not be successful. Conversely, if sealing is delayed too long, the teeth at highest risk to decay may already be carious. Bohannan and co-workers have estimated, that, for efficient sealant coverage, ninety percent of first and second molars could be sealed if the children were seen by approximately 7.8 and 13.4 years of age, respectively.[8] At these ages, the children would be in the second and eighth grades. Because premolars, which erupt earlier than second molars, may also be sealed, community-based sealant programs are recommended for children when they are in the second and sixth grades. The same children are recalled in the third and seventh grades to seal teeth that were insufficiently erupted in the previous year and to retreat teeth from which sealant was lost.

In addition to age, eruption times are also influenced by sex and race. During the period of permanent tooth eruption, for a given age, girls have 1 to 1.5 more teeth than boys and blacks and other minorities have more teeth than whites. The difference between 10-year-old blacks and whites is as much as three teeth. Early erupting teeth have a high immediate posteruptive susceptibility to decay. By age 7, 23 percent of erupted first molars have been reported carious and by age 13, 31 percent of second molars.[8]

Deciding which grades to include in a sealant program involves a compromise between having the maximum number of teeth available for treatment and the number that already would have developed caries. A program for second grade children could involve 95 percent of the first molars sufficiently erupted for sealant application; however, between 20 to 30 percent already could be carious.[8] If the sealant program has sufficient flexibility to set priorities in the selection of children for sealant application, special scheduling can be practiced in order to identify and treat children who are erupting posterior teeth early. These practices include:[8]

(1) See children in the spring, or last semester of the first grade. By contacting children late in the first year, early erupting teeth can be identified and may have sufficient crown height to obtain adequate isolation.
(2) If only second and sixth graders can be treated and the program will involve several months, schedule girls and blacks before the other children. Earlier treatment will enable some teeth to be sealed that would have developed caries if these children had been scheduled later in the school year.
(3) Schools with high minority enrollments should be scheduled first and schools with predominantly white children, with later eruption patterns, scheduled later.
(4) The recall schedule in the subsequent year for third and seventh graders should begin early in the fall in order to leave the later months of the year for the first, second and sixth graders who are being seen for the first time.

Tooth Oriented Criteria

One approach in a sealant program is to seal all caries free premolars and first and second permanent molars. This nondiscriminating approach has the advantage of protecting all pit and fissure surfaces from developing caries, but it has the disadvantage of deliberately sealing surfaces that may never decay. The premolars especially would be overtreated since, for a comparable time in the mouth, they are at least five times less susceptible to decay than the first permanent molars (see Table I—4)

Another approach is to seal all caries free first and second molars. Premolars would either not be sealed or would be sealed selectively. In a community or school district in which the caries prevalence is low, this approach still would result in sealing a significant number of teeth that might not decay.[33] However, in children who were selected by the community and school oriented

criteria described above, a high caries incidence in first and second molars would be expected with time and, therefore, this approach would be both practical and efficient.

When specific premolars and/or molars are to be identified for sealing in a program that has already used the multilevel community, school, and individual selection process, only the morphology of the teeth need be considered. If the teeth have deep narrow pits and fissures that tend to catch the tip of an explorer they should be sealed. These pits and fissures are difficult for the patient to clean and offer protective sites for bacteria and food debris to develop the acid conditions that lead to caries. Conversely, well coalesced pits and fissures with wide easily cleaned grooves need not be sealed since there is less tendency for these teeth to develop caries.

Whatever approach is used, the status of the proximal surfaces should be considered. In the community program described, children mainly in the second and sixth grades are treated. First permanent molars are sealed in the second graders and premolars and second permanent molars are sealed in the sixth graders. These teeth should not have been in the mouth long enough to develop proximal caries. Therefore, the diagnosis of proximal decay becomes moot, and, under these circumstances, radiographs are not necessary. Of course, the children should be encouraged to visit a dentist on a regular basis, and radiographs should be part of their dental care disassociated with the sealant program.

The buccal pit of mandibular molars and lingual groove of maxillary molars can be sealed at the same time the occlusal surface is treated. Frequently, however, a tooth will be sufficiently erupted for a dry field to be maintained on the occlusal surface but not on the buccal or lingual surface. If the tooth is incompletely erupted, crevicular fluid can seep onto the buccal or lingual surface and prevent the proper placement of sealant. The lingual groove of an incompletely erupted maxillary first or second molar is a classic example of this situation. When dryness cannot be maintained, buccal pits and lingual grooves should not be sealed. In fact, if a dry field cannot be maintained on the occlusal surface because of insufficient eruption, a lingual tissue tag, excessive salivation, or patient behavior the sealant treatment should be deferred to the next recall appointment.

Because of the division of the occlusal surface of maxillary molars by the transverse ridge, it is possible to seal only the mesial pit of these teeth if they are partly erupted when the child is first seen. The subsequent recall visit can be used to apply sealant to the distal pit and lingual groove since complete eruption should have occurred in the interim.

OBTAINING PROGRAM SUPPORT

Support from local constituencies is necessary to have a successful sealant program. Health officers of the state, county or city/town health departments or their designees must contact school related groups, local professional societies, parents and children. Parents must be informed about the value of sealants so that they will want them for their children, and children must understand what the treatment involves and why it is being done. The superintendent of schools, school board, principals and teachers must support the program. If the program is not conducted entirely in the school, children may have to leave the school and go to the treatment site. The support of local professional societies must also be enlisted.

Table IV-2 lists the various groups that should be contacted when starting a sealant program and indicates the type of information that should be conveyed to each. The Appendix contains a list of educational materials that are useful in promoting interest in sealants.

TABLE IV - 2

Groups that Should be Contacted When Beginning a Sealant Program and Information to be Conveyed

Group	Information
School-related groups or individuals Superintendent of Schools Principals Teachers School Physician and Nurses School Dentist and Dental Hygienists	Dental health is an important component of preventive health services for school children What sealants are and how they prevent decay The changing caries prevalence and the need for sealants Which schools would participate Which grades would participate How parents will be contacted and consent obtained Who administers the program Who screens the children How sealants are applied Treatment location. Is transportation required for children Length of time in each school Student's time away from class Responsibilities of school administrators, teachers, school nurses or hygienists, teachers aides, and custodial staff Follow-up Cost of program at the local level, if any
Local Professional Societies Dental Societies Dental Hygienists' Society Dental Assistants' Society Pediatric Medical Society	The changing caries prevalence and the need for sealants Sealants as part of a preventive dentistry program for school children The participating schools and grade levels Who administers the program How the program will be conducted Follow-up Impact on their practices How they can participate
Parents and Parent Groups Parent-School Organizations	What sealants are and how they prevent decay Why sealants are needed Which schools and grade levels are involved The safety and effectiveness of sealants Sealants are not a substitute for fluoride Who will apply the sealants Treatment location Time children will be away from class How long the sealants last How they will feel. What they will look like Is there a charge to parents
Children	What the chewing surfaces of the teeth look like Why the chewing surfaces need special protection against decay What sealants are How they are applied and by whom Treatment location and time involved How they look How they feel How long they last

PROGRAM DETAILS

School Cooperation

Once the program has been approved by the school board and/or superintendent of schools a meeting must be arranged with the appropriate school administrators of each school to discuss implementation details. Usually, the program will need to be adapted to the personnel, schedule, and physical resources of each school.

The school principal or designee does the following:

1. provides current class lists of lst (maybe), 2nd, 3rd, 6th and 7th graders;
2. provides list of school holidays, vacations, early dismissal days, examination days, field trips, graduation and other special programs that might affect the scheduling of the dental program;
3. arranges classroom education sessions for the children;
4. arranges informational session for the teachers, nurses, and other pertinent school personnel;
5. approves the dental program schedule relative to the school schedule and notifies teachers to cooperate when children in their classrooms will be involved;
6. provides names of parent organization officers and when parent organizations meet;
7. provides space if treatment is to be performed in school. Facilities needed include:
   a. large room with ample space for dental equipment, dental personnel and patients
   b. room must have working electrical outlets
   c. room should be capable of being locked when not in use, or locked storage closet provided
   d. room with running water is helpful, but not essential;
8. provides desk and chairs if necessary;
9. alerts custodial staff to cooperate with dental program in setting-up and moving equipment, providing electrical services, and providing other support as needed;
10. instructs school nurse to assist dental staff in providing medical information on children with health problems and contacting parents or children's physicians regarding any questions about the children's health history;
11. helps with transportation details if children are to be bused to dental treatment sites. Identifies the party responsible for children during transport. (Generally a sealant program is considered a school activity and the school will accept responsibility for the children's welfare); and
12. provides space, utility connections and custodial assistance if treatment is to be provided in a dental van or trailer.

Promotion

The sealant program should be promoted in the community prior to the distribution of consent forms to parents. Publicity can be generated through local radio and television programs and through the newspapers. Presentations should be given before parents' groups and in the classrooms of children who will be participating (see Table IV—2). Sealant information can also be distributed at local health fairs and other community and school events. An active promotional campaign that involves both parents and children should produce a high return of positive consent forms.

Consent

As with any school-based dental preventive program, a consent form or permission slip signed by a parent or guardian must be received before a child can be treated in a sealant program. Basic elements of a consent form have been developed and include:

1. an explanation of the procedures being performed;
2. a statement of any known risks or discomforts that are reasonable to expect;
3. an offer to answer any inquiries concerning the program;
4. an instruction that the program is voluntary; and
5. the recognition that the preventive program should not take the place of regular dental care by the child's own dentist or of proper home care.

For sealants, a brief medical history questionnaire should be included on the consent form. Also, if the children will be transported out of their school to the treatment site, it should be stated on the consent form.

The consent form should be written in nontechnical terms so that it can be understood easily by parents. If the community contains a nonEnglish speaking population, the form should contain the necessary explanation in all pertinent languages so that it can be read and signed by the parents. The Appendix contains a sample consent form in English. It may be translated into other languages depending upon local need.

Consent forms may bear the letterhead of the local school or of the local health organization conducting the sealant program. At least 25 percent more forms than the number of possible participants should be printed. The extra supply is needed for second notices and for students who enroll in school after the program starts. If pamphlets describing sealants are used, they should be distributed with the consent forms and may be stapled to them.

The consent forms should be issued during a two-week period that has no holidays or vacation days. Mondays and Fridays are poor days to distribute forms because absenteeism is usually high. Teachers should be reminded to request the students to return the forms the next day.

The returned forms should be collected each day and the children's names checked off classroom lists. Nonrespondents should be encouraged to bring in forms. A second distribution of consent forms should be made to students who do not respond.

The forms should be separated into participating and nonparticipating groups, alphabetized by group, and filed for future reference.

Screening Examinations

A dentist and recorder conduct a mirror and explorer dental examination for caries on the children who returned positive consent forms. In some states, dental hygienists are legally permitted to conduct the examinations. The screening identifies the teeth that will be sealed. The parents or guardians of children with obvious disease should be notified by letter that their children need dental treatment outside of the program. Sealant applications should begin as soon as possible after the screening examination.

Personnel for Sealant Application

Ideally, the personnel includes an operator and assistant. The operator must be at the professional level consistent with the particular state's dental practice act concerning the application of sealants. Since studies have shown that the clinical skills and expertise of the operator are the primary factors in successful sealant retention, the operator should be trained and experienced in the application of sealants.[34,35]

A dental assistant assists chairside in the application of the sealant, maintains the record of each child as he or she receives treatment, and facilitates the flow of patients between the classroom and treatment room. While an experienced dental assistant is desirable, volunteer parents can be trained to perform these functions.

Equipment and Supplies

If the sealant program is conducted in a dental office, local health center or health department, or a dental trailer or van, the dental equipment needed for sealant application is already available. The main concern is that the air line be free of contaminating oil or moisture. If the program is entirely school-based, portable equipment is needed. Table IV—3 contains a representative list of portable equipment[36] and the Appendix provides specifications for the equipment as well as suppliers. The portable equipment should be sturdy, yet light enough to be transported between

TABLE IV - 3

Portable Equipment for Community Sealant Program

Patient dental chair
Operator and assistant stools
Extra-oral light
Portable dental unit with high volume suction
Air compressor, dryer and filter
Dry heat sterilizer
Ultrasonic instrument cleaner
Table for instruments (if work surface is not provided with the dental unit)
Visible light curing unit (if visible light cured sealant is used)

schools. The patient dental chair should be a portable metal frame chair. Cardboard portable chairs are unsatisfactory for sealant treatment programs in which patient position and operator comfort is an important consideration.

Table IV—4 lists supplies that are commonly used in community sealant programs. They should be available whether the treatment is conducted with portable or stationary equipment.

TABLE IV-4

Supplies for Community Sealant Program

mirrors
explorers
cotton pliers (lock type)
disposable prophy angles
disposable prophy cups or brushes
cotton roll holders
cotton rolls
cotton pellets
saliva absorbers
disposable aspirator tips
disposable dappen dishes
bib holder
patient bibs
disposable paper napkins
disposable examination gloves (non-sterile)
hand disinfectant foam
surface disinfectant and wipes
sterilizer bags
instrument tray for used instruments
flour of pumice
plastic patient aprons
unfilled sealant kit
safety glasses for visible light cured unit (if visible light cured sealant is used)

Source: Modified from Disney, J. A., J Dent Ed, 1984.

A sealant should be considered that has been accepted or provisionally accepted by the American Dental Association (see Appendix). Autopolymerized sealants have the advantages of not requiring a light curing unit or needing an additional electrical outlet. Nevertheless, both autopolymerized and visible light polymerized systems are being used successfully in community preventive dentistry programs. Because of the lower retention rates for ultraviolet light cured sealants, compared to autopolymerized sealants, they are not recommended. Partially filled sealants which may require occlusal equilibration also are not recommended. Tinted or opaque sealants are easy to see and their presence is easily recognized by both the provider and recipient. The better visibility of these systems, therefore, is an advantage to be considered when selecting a sealant brand for a community sealant program.

Treatment Schedule

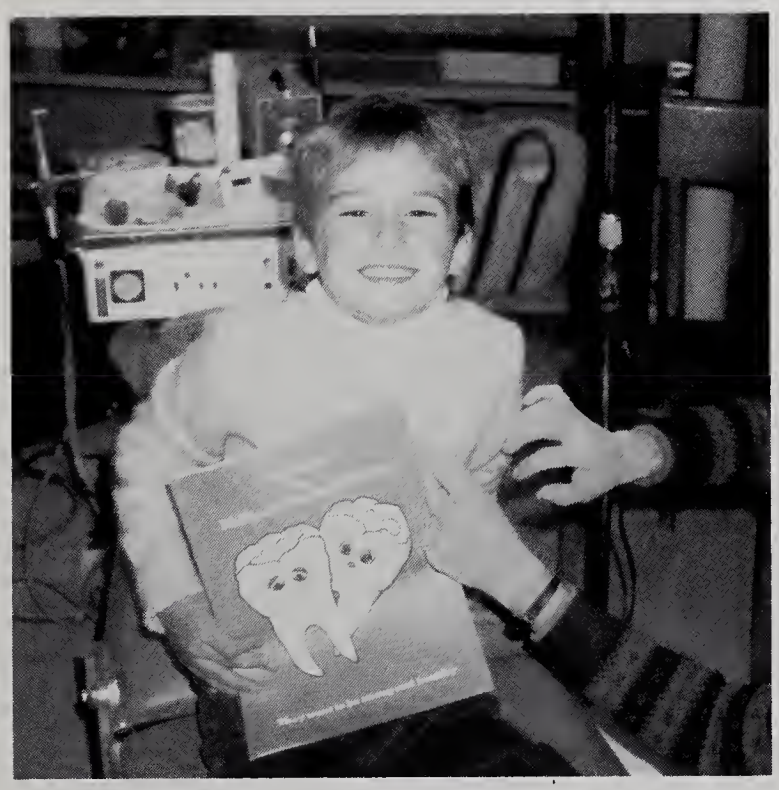
A scheduling system should be designed that maintains a steady flow of patients, yet allows the operator time to perform effectively and the school staff the flexibility that they require. Generally, the first and last half hour of the school day are reserved for school activities and an hour in the middle of the day is set aside for lunch. This usually leaves about four hours available for sealant applications.

It takes approximately 20 minutes per child to treat four teeth. Considering travel time from the classroom and putting the child at ease, a child might be out of the classroom for 30 minutes. An operator and an assistant could treat approximately 12 children per day. Fewer children would be treated if the operator is functioning alone.

If sealants are applied at the school, either a one- or two-patient scheduling system can be utilized. The one-patient system works as follows: The teacher sends the child to the sealant application site. The child receives his/her sealant(s), returns to class and requests the teacher to send the next child. This system allows the operator ample time between patients to complete related records and to prepare for the next child. While the system allows an operator to work alone, it is inefficient when the operator works with an assistant.

The two-patient system works as follows: Initially, the teacher sends two children to the sealant application site. One child is the patient, the other child an observer. The patient receives his/her sealant(s), returns to class and requests the teacher to send the next child. The previous observer now becomes the patient and the new child becomes the observer. This system enables the operator to maintain a steady flow of patients throughout the day. It also allows the children to observe the sealant procedure, relieving their anxiety about the procedure.

If the sealants are applied away from school, a bus or van will be necessary to transport the children to the treatment location. Several children will be transported at the same time and they may have to wait until the entire group is treated before they are returned to the school. Sometimes the operatory will be within walking distance; however, adult supervision probably would still be necessary, especially for the younger children.



Records

Records for a sealant program should include:

1. a file of the original signed consent forms;
2. an alphabetical file of participating children. File cards should include the child's name, address, phone number, and the school, grade level and teacher or homeroom number by academic year;
3. a treatment card for each child indicating what teeth were treated, when, and whether sealants were applied at the initial or recall visit. Any remarks specific to an individual child's treatment should be included (Files #2 and # 3 may be combined);
4. an inventory of supplies; and
5. a record of expenses.

Follow-up

During the next school year, children who were treated the previous year should be recalled and examined. Sealant should be reapplied to surfaces from which partial or complete loss of sealant occurred. Eligible teeth that were unerupted or partially erupted at the initial visit should also be sealed.

Feedback

To maintain interest and sustain support, periodic reports of the program's progress and accomplishments should be provided to school staff, school administrators, participants and their parents, and local professional societies.

Cost

Costs for a preventive dentistry public health program include capital and operating costs. Capital costs are amortized over time, while operating costs represent recurring annual expenditures.

Capital costs for a sealant program will vary according to the facility in which it is conducted. For instance, if temporary sites must be established in schools, capital costs are for portable equipment including chair, unit, compressor, light, and stools for each treatment team. Conversely, if the program is conducted in a permanent treatment facility, the necessary dental equipment is already available. If a light cured sealant is used, the curing units represent an additional cost.

Operating costs include salaries, maintenance, supplies, and public education efforts. If children are transported to treatment centers or if the operating teams must go to the children's schools, travel is an additional operating cost.

Calderone and Mueller calculated the costs of sealants in a state dental disease prevention program in New Mexico. They reported the costs to be $1.59 per tooth and $7.41 per child.[37] These figures agree with Hardison's reported costs of $1.20 per tooth and $8.00 per child in a community public health sealant program in Tennessee.[38] Others, however, have reported higher costs,[39-41] ranging from $12.39[39] to $36.41[41] per child. The wide range of reported costs has been attributed to several factors including the degree of economics training of those performing the analysis. Variations in program size, available resources, location, and salary

and fringe benefit differentials contribute to the difference. These programmatic variables are the reasons why standardized figures for running a community-based sealant program cannot be given. However, factors that influence costs can be enumerated and the following list should provide a basis for assessing an individual sealant program in which the specifics are known.

1. Start-up costs
   - A. Personnel time required to:
     1. secure the cooperation of the school system and the support of other local groups
     2. develop a record keeping, appointment, and recall system
     3. develop a treatment protocol
     4. develop consent forms and record forms
     5. hire dental personnel
     6. develop a quality assurance method
     7. make necessary purchases
   - B. Capitol equipment purchases
   - C. Dental supply purchases
   - D. Clerical supply and equipment purchases
   - E. Printing costs
   - F. Educational materials purchases including brochures, films, audio-visual equipment
2. Continuation Costs
   - A. Salaries and fringe benefits of dental and clerical personnel. Personnel with direct responsibility for treating children and whose only duty is to the sealant program should be hired on a schedule that conforms to that of the school's. Thus, these personnel would be nine-month, academic year, employees, working approximately six hours a day on school days in full session.
   - B. Maintaining expendable dental supply inventory
   - C. Equipment maintenance, repair, and replacement
   - D. Maintaining clerical supply inventory
   - E. Transportation costs. This expense includes transportation of children to and from their schools if the treatment location is elsewhere; transportation of trailers and vans, including insurance, if the program is conducted in a dental vehicle; transportation of personnel and portable equipment to and between schools if the program is conducted entirely within the schools.

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APPENDIX

CONTENTS

Policy Statements and Endorsements

American Academy of Pediatric Dentistry

"The American Society of Dentistry for Children and The American Academy of Pedodontics affirm the use of pit and fissure sealants as a safe and effective method of reducing tooth decay in the occlusal grooves, pits and fissures of posterior teeth."

- ASDC J. Dent Child, 1983,
- Pediatr Dent, 1983,
- J. Dent Ed, 1984

American Association of Public Health Dentistry

"The American Association of Public Health Dentistry recognizes that pit and fissure sealants are safe and effective as a caries preventive procedure. The Association strongly endorses the use of sealants as a part of the total caries preventive program for both public health and private sector caries prevention programs. The Association urges that dental health professionals develop a thorough understanding of and appreciation for this procedure and increase its use to ensure the benefits of pit and fissure sealants to all segments of the population."

- J. Dent Ed, 1984

"Resolved, that the American Association of Public Health Dentistry strongly supports and encourages the use of pit and fissure sealants as well as fluorides in private dental practices and public dental health programs,

Resolved, that the Association supports the inclusion of pit and fissure sealants as a covered preventive service in public and private third party payment programs, and be it further

Resolved, that the Association urges health agency directors and practitioners to increase the public's awareness of this dental caries preventive measure."

- adopted 1984

American Dental Association

"Currently, the Council considers that pit and fissure sealants are safe and effective as a caries preventive procedure. The treatment is especially effective when pits and fissures of selected first and second molars are sealed soon after their eruption. Pit and fissure sealants should be used as part of a total caries preventive program that also includes, among others, optimum fluoride treatment and restricted frequency of refined carbohydrate intake."

- JADA, 1983
- J. Dent Ed, 1984

American Dental Hygienists' Association

"1. Dental hygienists, as well as dentists have a responsibility to the public to inform and educate consumers on the effectiveness of sealants in preventing dental caries;

2. Dental hygienists, through their constituent and component organizations, should accept responsibility to promote the wider use of sealants by dentists in their practices; and

3. Dental hygienists, through their constituent and component organizations, should accept responsibility to inform dental consumers about the efficacy of applying pit and fissure sealants as a most effective caries prevention agent, particularly for children."

- J. Dent Ed, 1984

"The American Dental Hygienists' Association recognizes that the use of pit and fissure sealants, when properly applied and retained, is one acceptable component of the multiple approach to the prevention of occlusal dental caries."

- adopted 1977

American Public Health Association

"1. Strongly supports and encourages the appropriate use of pit and fissure sealants in private dental practices and public dental programs; and

2. Supports the inclusion of pit and fissure sealants as a payable preventive service in private dental insurance programs and in public dental programs, particularly State Medicaid dental programs."

- adopted 1984
- Am J. Public Health Dent, 1985

American School Health Association

"Be it resolved, that the American School Health Association supports the use of pit and fissure sealants for caries-susceptible school-aged youth."

- adopted, 1984

Association of State and Territorial Dental Directors

"The Association of State and Territorial Dental Directors endorses and recommends sealants in community-based programs for the prevention of occlusal dental caries."

- J. Dent Ed, 1984

"Be it resolved that the ASTDD strongly supports and encourages the appropriate use of pit and fissure sealants in private dental practices and public dental health programs, and

Be it further resolved, that the ASTDD supports the inclusion of pit and fissure sealants as a reimbursable service in dental prepayment programs, particularly State Medicaid programs."

- adopted 1985

TABLE A - 1
American Dental Association Classified Sealants

Brand	Manufacturer	ADA Classification*	Method of Polymerization	Presence of Fillers	Color
Concise Brand White Sealant	Minnesota Mining and Manufacturing Company	Acceptable	Autopolymerized	No	White
Delton	Johnson & Johnson Dental Products Company	Acceptable	Autopolymerized	No	Clear
Delton (tinted)	Johnson & Johnson Dental Products Company	Acceptable	Autopolymerized	No	Tinted (Amber)
Nuva-Cote	L. D. Caulk Company Division of Dentsply International, Inc.	Acceptable	Ultraviolet Light	Yes	Cloudy
Nuva-Seal P.A.	L. D. Caulk Company Division of Dentsply International, Inc.	Acceptable	Ultraviolet Light	No	Clear
Oralin Pit and Fissure Sealant	S. S. White Company Dental Products International	Acceptable	Autopolymerized	No	Clear or tinted (pink)
Prisma-Shield	L. D. Caulk Company Division of Dentsply International, Inc.	Acceptable	Visible Light	Yes	Cloudy
Visio-Seal	ESPE	Acceptable	Visible Light	No	Clear or tinted (pink)
Helioseal	Vivadent (USA), Inc.	Provisionally Acceptable	Visible Light	No	Opaque White
Delton Light Cure	Johnson & Johnson Dental Products Company	Provisionally Acceptable	Visible Light	No	Clear

*JADA, Nov. 1985

TABLE A - 2

Partial List of Photoactivation Units

BRAND *	MANUFACTURER	LIGHT EMISSION
Nuva-Lite Photo Cure Unit	L. D. Caulk Company Division of Dentsply International, Inc.	Ultraviolet
Coe Lite	Coe Laboratories, Inc.	Visible
Command Light	Kerr Division of Sybron Corporation	Visible
ESPE Elipar Visible Curing Light	ESPE - Premier Sales Corporation	Visible
Heliomat	Vivadent (USA) Inc.	Visible
Insight Auto Light Fiber Optic Light Cure System	Midwest Dental	Visible
Opti-Lux	Demetron Research Corporation	Visible
Opticure Total Light System	Dencoa	Visible
Prisma-Lite	L. D. Caulk Company Division of Dentsply International, Inc.	Visible
Quartzfire Sx Fiber Optic Handpiece and Visible Light Curing Unit	Lares Research, Inc.	Visible
Spectra-Lite	Pentron Corporation	Visible
Sunlite Polymerization System	Kinetic Instruments, Inc.	Visible
Translux	Kulzer, Inc.	Visible
Visar 2 Curing Unit	Den-Mat Corporation	Visible
Visible Light Curing Unit	B. L. Dental Company, Inc.	Visible
Visilux 2	Minnesota Mining and Manufacturing Company	Visible

* Dentists' Desk Reference: Materials, Instruments and Equipment, A.D.A., 2nd Ed., 1983 and P. L. Fan, personal communication

TABLE A - 3

Partial List of Protective Glasses and Shields for Photoactivated Sealant Systems

BRAND	MANUFACTURER OR SUPPLIER	AVAILABLE AS
Elipar Light Cure Shield	Premier Dental Products	hand-held shield (3 pack)
Guardian Eye Glasses	Buffalo Dental Manufacturing Co.	plastic frame glasses plastic frame with flip-up lenses clip-on, flip-up
Visible Curing Light Glasses	Orthotronics	metal frame glasses plastic frame glasses clip-on, flip-up
Younger Protective Lens Series	Younger Optics	PLS 530 series lenses available in plain or prescription form through authorized laboratories
Noviol	American Optical Corporation	safety thickness 3.0. mm., plastic frame glasses (frame F-199 or F-98) clip-on, flip-up (frame 24W)
Ray Bloc	Carl Parker Associates, Inc.	plastic frame glasses, regular or with side shields clip-on, flip-up
Color Lens	Kulzer, Inc.	metal frame glasses clip-on, flip-up

A number of optical companies manufacture devices to protect the eyes of the operator and assistant when working with photoactivation units. These include hand-held shields, eyeglasses, and eyeglass clip-ons. The above list is a representative sample. The manufacturers of these products traditionally are not in the dental field, but their products can be obtained through most dental supply companies. There has been little independent testing of these devices.

TABLE A - 4

Partial List of Sealant Patient Education Materials

TITLE	TYPE	SOURCE	DESCRIPTION	FEE
Seal Out Decay (W191)	Pamphlet	ADA Order Department	Explains how sealants protect decay prone tooth surfaces, who should be treated, and how sealants are applied. Illustrated with before and after photographs of a sealant treated molar.	Yes
Sealants (X617-16 mm) (X827-video)	16 mm film Videocassette	ADA Order Department	Three minute message for teaching parents about what sealants are, who can benefit from them, the application procedure, and their effectiveness.	Yes
Enamel Fissure Decay (W374)	Wall plaque	ADA Order Department	Shows how irregularities in molar surfaces can trap plaque, despite brushing; how decay spreads beneath tooth surfaces; and how untreated cavities get worse.	Yes
Seal Out Enemies (W375)	Wall plaque	ADA Order Department	Cartoon illustrations and captions explain how pits and fissures of molars and bicuspids harbor decay causing plaque and how sealants prevent decay.	Yes
Seal Out Decay (W379)	Wall plaque	ADA Order Department	Shows and tells why chewing surfaces need a sealant. With photographs.	Yes
About Pit & Fissure Sealants for Your Child's Teeth	One Page Sheet	American Society of Dentistry for Children	Describes pits and fissures; Discusses the need for scalants; answers the questions, what are occlusal sealants and how long will they last.	Yes
Sealants and Fluorides (Poster 1)	Poster	NIDR	Sealants and Fluorides: A Winning combination for tooth protection. Picture of smiling child. *	No
Sealants and Fluorides (Poster 2)	Poster	NIDR	Sealants + Fluorides = maximum protection against cavities. *	No
Seal Out Dental Decay (NIH Pub. NO 83-1140)	Pamphlet	NIDR	Describes sealants and their need. Discusses how sealants protect the teeth.	No
A Barrier to Help Seal Out Decay	Pamphlet	Johnson & Johnson Dental Products Co.	Describes why chewing surfaces need sealant protection and discusses the use of Delton.	No
Sealants Prevent Decay (E08)	Pamphlet	American Society of Dentistry for Children	Answers questions about sealants in lay language.	Yes
Help Your Child Fight Cavities in Places a Tooth-brush Can't Reach	Pamphlet	Vivadent (USA), Inc.	Describes the use of Helioseal in nooks and grooves that toothbrushes can't reach.	No, initially
A Plastic Shield that Prevents Cavities. Tooth Sealants (542503)	Pamphlet	L.D. Caulk Co. Div. of Dentsply Int.	Shows how sealants protect teeth using Nuva-Cote.	No
A Plastic Shield that Prevents Cavities. Prisma Shield (543910)	Pamphlet	L.D. Caulk Co. Div. of Dentsply Int.	Shows how sealants protect teeth using Prisma Shield.	No
Q. Is Fluoride the Only Way to Protect Bobby from Tooth Decay? A. No, There's Concise White Sealant. Ask Your Dentist About It.	Kit	Minnesota Mining and Manufacturing Co. Dental Products Division	Promotion kit contains one 15" x 20" poster, 50 pamphlets, a pamphlet holder, an easel for pamphlets, direction sheet for how to use the kit. Pamphlet instructions describes how sealants work using Concise, how children benefit from sealants, and how sealants fit into a regular dental program.	Yes
Sealants and Fluorides	Bookmark	NIDR	Sealants + Fluorides = maximum protection against cavities.	No
Seal Out Dental Decay NIDR Fact Sheet	One Page Sheet	NIDR	Explains the need for sealants. Tells the types of sealants and how they protect the teeth from decay.	No
Dental Sealants in the Prevention of Tooth Decay. NIH Consensus Development Conference Statement Volume 4 Number 11	18-Page Brochure	NIH - Office of Medical Applications of Research	Contains the conclusions of the NIH Consensus Development Conference on Dental Sealants which was convened by the National Institute of Dental Research in December, 1983.	No

*** Also available in Spanish**

State or local dental directors also may have educational materials available.

TABLE A - 5

Partial List of Available Portable Equipment for Community Sealant Programs and Sources

ITEM	DESCRIPTION	SUPPLIER/MANUFACTURER
Portable Chair	Porta-Chair 3460 with arm rests and light post extension (Rolux light only)	A • dec 2601 Crestview Drive Newberg, OR 97132
Portable Chair	Aseptichair-ADC-01 with arm supports, 30 lbs., carrying case	Aseptico P.O. Box 522, Kirkland, WA 98083
Stools	Operator and assistant	Local dental supplier
Portable Fiber Optic Light	ALU 28 or 29 Starbeam, chairmount or stand model for use with Aseptichair	Aseptico P.O. Box 522, Kirkland, WA 98083
Portable Fiber Optic Light	MDT Rolux Light 3-12-1011-30 for the A • dec Porta Chair	MDT Instrument Co. P.O. Box 10688 7371-B Spartan Blvd. East North Charleston, SC 29411-0668
Portable Prophy Unit	Prophy-mate-Brahler with rheostat (specify staight cord) plus, plastic disposable prophy angles, prophy cups, webbed snap-on, soft	Local dental supplier
Portable Unit	Spartan Mobile Dental Unit OM-1. A 95 lb. unit on casters. Standard equipment includes built-in air compressor, vacuum system with holding tank and water cannister, 2 handpiece hookups, 3-way syringe, saliva ejector, high volume hose, foot control, master on/off switch, 2 drawer storage, 2 electrical outlets, water quick connect.	Spartan U.S.A. 1725 Larkin Williams Road Fenton, Missouri 63026
Portable Unit	ADU-10 Asepti Mini Unit - 14¾" x 13¾" x 11¾" unit weighing 24 lbs. Includes automatic controls for 2 handpieces 3-way syringe, quick disconnects and built-in water system. Can add high volume suction and/or saliva ejector which runs off separate compressor.	Aseptico P.O. Box 522 Kirkland, WA 98083
Compressor	AA-71 compressor - ¾ horsepower. Weighs 42 lbs., 110 v (220 v available)	
Compressor Case	AA-17. Carrying case for compressor AA-71	
Portable Unit	A • dec Field Porta • dec 3415. A 33" fixed height frame unit which can be dismantled for transportation in its own case. Weight: 45 lbs. Tray and work surface 18" x 21". Two handpiece high- or low-speed with disc foot control, Tri-flo II syringe, saliva ejector adapter with tubing and tip valve. Self contained 64 fl. oz. water tank.	A • dec 2601 Crestview Drive Newburg, OR 97132
Compressor	AA-71 compressor - ¾ horsepower. Weighs 42 lbs., 110 v (220 v available) .	Aseptico P.O. Box 522
Compressor Case	AA-17. Carrying case for compressor AA-71.	Kirkland, WA 98083
Ultrasonic Cleaner with Timer	L & R Model T14B. 8⅝ lbs. cleaning tank has 3⅜ quart capacity. With heater and timer and with (optional) accessory package. 110 volt or 220 volt	L & R Manufacturing Co. 577 Elm Street Kearney, NJ 07032 Unit available from most dental supply companies.
Dry Heat Sterilizer	Dri Clave Dry Heat Sterilizer. Model 75. Outside dimensions: 15½ W x 10½ H x 9" D. Inside dimensions: 11½ W x 5" H x 7¼" D. 17 lbs. shipping weight. Includes 2 instrument trays plus small tray. 110 volt or 220 volt.	Columbus Ivory 1000 Chouteau Avenue St. Louis, MO 63188 Unit available from most dental supply companies.

SAMPLE CONSENT FORM

(Letterhead of Health Agency Conducting Program)

Dear Parent:

The _____ (Local or State) Health Agency in cooperation with the _____ school system is offering a preventive dental program to children in grades 2 and 6. This program has the support of the _____ Dental Association.

The program consists of the application of sealants to the permanent back teeth. Sealants are plastic coatings that are applied principally to the chewing surfaces of the back teeth. These surfaces are difficult to clean with a toothbrush. The sealants prevent cavities by sealing the tiny crevices of the teeth from germs and food particles. The use of sealants is a safe and effective way to prevent cavities and is recommended by the American Dental Association. The application of sealants is a minimum risk procedure that is no greater than that associated with a routine dental examination and cleaning. If the sealant comes off a tooth, it is at no greater risk to developing a cavity.

As part of this program, your 2nd or 6th grade child will receive a dental screening (without x-rays) and have sealants applied to the permanent back teeth which are free of cavities. Your child will be seen again in the 3rd and 7th grades for any additional sealant treatment that might be necessary.

Participation in the sealant program is voluntary and there is *no cost* to allow your child to participate. This program will not take the place of regular dental check-ups, daily brushing and flossing, using fluoride and limiting sweets.

If you want to have your child participate, please fill out the form below and return it to your child's teacher. If you do not want your child to participate, also, please so designate on the form below.

If you would like more information call _____.

Sincerely,

_____

Program Director

Tear off and Return

☐ Yes: I want my child to participate in the sealant program. I understand that I can withdraw my child from participation in the program at any time.

☐ No: I do not want my child to participate in the sealant program.

PLEASE PRINT

Name of Child _____ Age _____
(Last) (First) (Initial)

Date of Birth _____ Sex _____
(Month) (Day) (Year)

Name of School _____

Teacher _____ (Grade) _____

HEALTH HISTORY

- Has your child ever been seriously ill? Yes [ ] No [ ] If yes, please list all serious illnesses: _____
- Has your child ever had rheumatic fever? Yes [ ] No [ ] bleeding problems Yes [ ] No [ ] bad reaction to medicines Yes [ ] No [ ]
- Is your child now under the care of a physician? Yes [ ] No [ ] If yes, give reason: _____
- Does your child take any medicines? Yes [ ] No [ ] If yes, give reason: _____
- Is your child allergic to anything? Yes [ ] No [ ] If yes, what: _____
- Is there anything else we should know about the health of your child? _____

Signature of Parent or Guardian _____

ADDRESSES

American Dental Association
Order Department
211 East Chicago Avenue
Chicago, IL 60611

American Optical Corp.
14 Mechanic Street
Southbridge, MA 01550

American Society of Dentistry
for Children
211 East Chicago Avenue
Suite 920
Chicago, IL 60611

B.L. Dental Co., Inc.
135-24 Hillside Avenue
Richmond Hill, NY 11418

Buffalo Dental Mfg. Co.
575 Underhill Blvd.
Syosset, NY 11791

Carl Parker Associates, Inc.
150 Broad Hollow Road
Melville, NY 11747

Coe Laboratories, Inc.
3737 W. 127th Street
Chicago, IL 60658

Demetron Research Corp.
5 Ye Olde Road
Danbury, CT 06810

Dencoa
2300 Marilyn Park Road
P.O. Box 19826
Columbus, OH 43219

Den-Mat Corp.
3130 Skyway Drive, Unit 501
Box 1729
Santa Maria, CA 93456

ESPE
200 Lake Avenue
Lake Worth, FL 33460

Fred B. Eggler
700 Sputtgard - Busnav
Kaindlstr 3
West Germany

Johnson & Johnson
Dental Products Co.
20 Lake Drive
East Windsor, NJ 08520

Kerr
Division of Sybron Corp.
Dental Products Div.
28200 Wick Road
Box 455
Romulus, MI 48174

Kinetic Instruments, Inc.
Berkshire Blvd.
Bethel, CT 06801

Kulzer, Inc.
10005 Muirlands Blvd.
Unit G
Irvine, CA 92714

Lares Research, Inc.
1581 Industrial Road
San Carlos, CA 94070

L.D. Caulk Co.
Div. of Dentsply International, Inc.
Lakeview and Clarke Aves.
Milford, DE 19963

Midwest American
Div. of Sybron
901 W. Oakton
Des Plaines, IL 60018

Minnesota Mining and Manufacturing Co.
3 M Center, 255-1S
St. Paul, MN 55144

National Institutes of Health
National Institute of Dental Research
Westwood Building Room 522
5333 Westbard Ave.
Bethesda, MD 20892

National Institute of Health
Office of Medical Applications
of Research
Building 1, Room 216
Bethesda, MD 20205

Orthotronics
29 North Main Street
Gloversville, NY 12078

Pentron Corp
121 N. Plains Industrial Road
Box 771
Wallingford, CT 06492-0771

Premier Dental Products
1710 Romano Drive
Norristown, PA 19404

S.S. White Co.
Dental Products, International
Box 100
Holmdel, NJ 07733

Vivadent (USA), Inc.
182 Wales Avenue
Tonowanda, NY 14150

Younger Optics
3788 South Broadway Place
Los Angeles, CA 90007

NOTES

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SAVE TEETH
SEAL THEM